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Lubricating Mechanisms

Some Types and Principles

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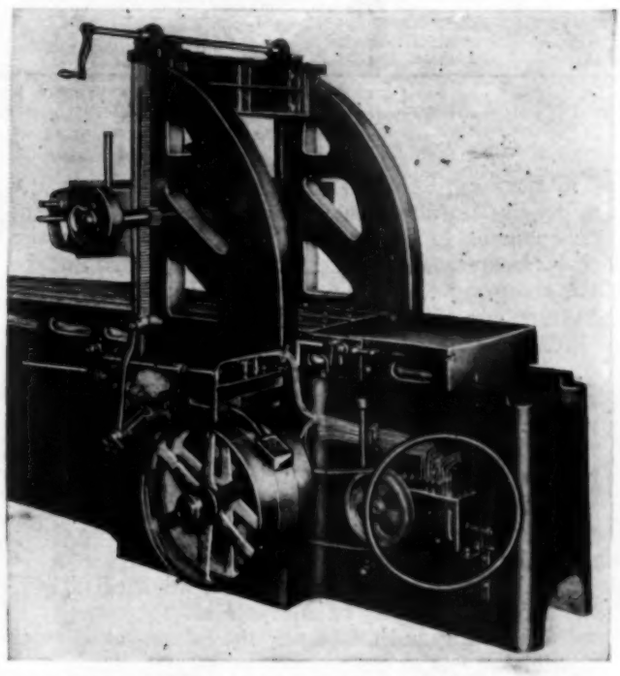
IN THE design of the wearing elements of any type of production machinery, it is important to remember, not only that a lubricating film must be developed, but also that it must be maintained positively at all times, to prevent the possibility of metal-to-metal contact and solid friction. The means of lubrication must be given very careful consideration, both in the design of new equipment and in its subsequent operation. This article deals with automatic pressure lubrication, and not with lubricating equipment that is distinctly dependent upon manual adjustment for its continued operation.

Mechanical devices which can be depended upon to maintain lubrication continuously and positively are preferred today, almost without regard to the product involved or the nature of the machinery, for such equipment tends to insure that production schedules will be more closely maintained, that repair costs will be reduced, and the life of machinery extended.

Both the designer and user of production equipment need to consider carefully the factors upon which satisfactory lubrication depends. Many of these factors are set forth in logical fashion in this article



A compact lubricating arrangement is provided on many machines by the application of a force-feed lubricator. The Whitcomb planer with its Madison-Kipp lubricator shown above is a typical example of this practice

All types of lubricating equipment which may be considered in a discussion of the mechanism of automatic pressure lubrication can be divided broadly into two classifications, according to whether oil or grease is involved. Where dealing with oil, it is desirable to consider:

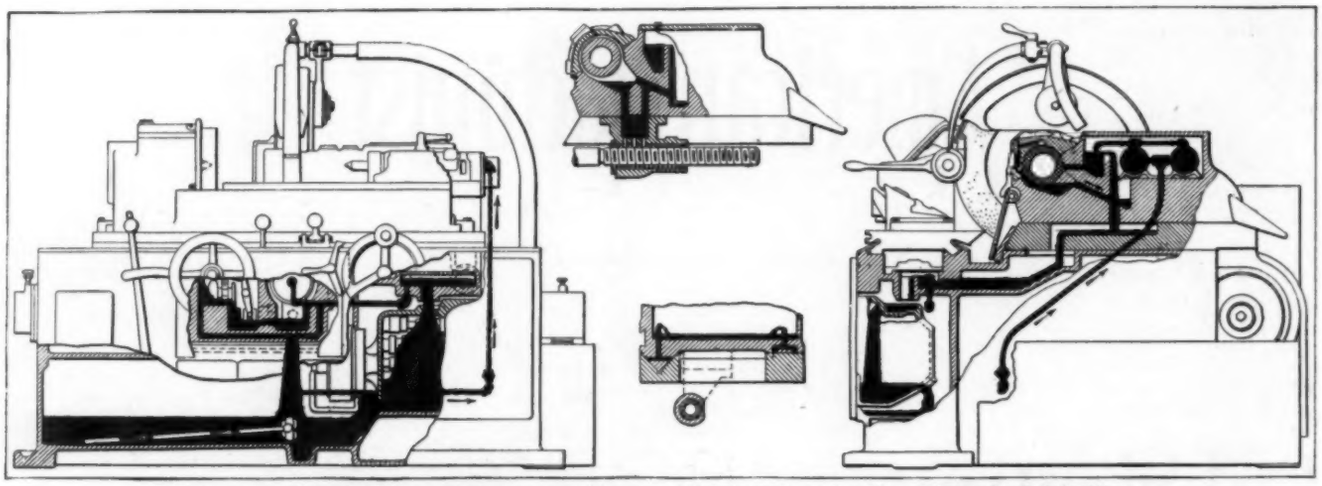
1. The chain- or gear-driven oil pump.
2. Centralized pressure systems
3. The mechanical force-feed oiler.

In the cast of grease, the two types of devices to be dealt with are:

1. The spring type of grease cup and
2. The power driven greasing device.

Where lubrication with oil under pressure is involved, it is practical to employ either hand power or mechanical means for distributing the lubricant. The latter is more positive and requires less attention, especially where the lubricating system operates from the machine to be oiled. Manually operated centralized systems of oil lubrication, in which initial pressure is developed by pushing or pulling a plunger or by turning a wheel to bring about compression, on the other hand, frequently are more economical.

Gear pumps have attained decided prominence as dependable lubricating devices especially in automotive en-



Some machine-tool manufacturers provide a self-contained and fully automatic lubrication system, using a gear pump to circulate oil to all bearing surfaces. The Brown & Sharpe grinder here illustrated is fitted with this type of lubricating mechanism

gine lubrication. It is, in fact, so absolutely automatic as to require no attention whatsoever after adjustment has been made to assure maintenance of the requisite oiling pressures. Such pressures, of course, must be varied according to engine and bearing design. In the aircraft engine, for example, a higher pressure is required than is usual in automotive service.

Where application is to be made to machine tools or other such equipment, however, the pumping device may be of either the gear or of some other rotary type. A typical example of the latter is found in the automatic oiling system employed for lubrication of the bearings of certain grinding machine spindles. The normal location of such a pump is in the base or sump of the machine to be served, below the operating oil level. In view of the fact that continuous circulation of oil prevails, there always must be adequate storage capacity to permit of cooling and settling of the return oil as much as possible.

The pressure involved in such circulation and the volume of oil delivered to the wearing elements enables the oil to serve as a flushing and cooling medium. As a result, more or less contaminating or non-lubricating matter may be accumulated in the course of circulation. A certain amount of heat also may be taken up from the bearings. This depends, however, upon the construction of the lubricating system, the speed of operation, the bearing pressures, and the proximity to production or power generating equipment which may be developing high temperatures or dust.

Flow of oil can be controlled by installing suitable valves in the respective delivery lines, regulating same after noting the flow in sight feed glasses located adjacent to the parts to be lubricated.

Built-in systems of lubrication of this nature are decidedly positive and virtually automatic in regard to the extent to which they maintain lubrication. This should not be regarded, however, as reason for overlooking the importance of changing oil at regular intervals. On the other hand, the frequency of oil change varies with the type of machine and the means, such as oil filters or air filters, provided for reducing or preventing oil contamination during operation.

It is unwise to assume arbitrarily that change of oil after a certain length of operation will suffice; the controlling factors have too great an effect. In this regard, the extent to which dust or dirt may be present, the tightness of the system, the bearing pressures, the rate of oil circulation, the possibility of entry of water, the operating speeds and temperatures and the original purity of the oil, require consideration.

Where the nature of construction is such as to prevent possible entry of abrasive metallic particles or dust from surroundings, effective lubrication is practicable over an extended period of operation if the oil screen or filter adjacent to the pump is cleaned regularly. In such a case it is necessary only to add a small amount of make-up oil at periodic intervals.

In contrast with self-contained systems of pressure lubrication, it is interesting to note that centralized pressure lubrication has been developed to a marked degree of late. In such systems automatic delivery of oil is effected from a central reservoir, the wearing parts involved being flushed automatically and supplied at the same time with oil or light grease. The reservoir can be located adjacent to the machine to be lubricated, within easy reach of the operator. By equipping it with a suitable plunger, pump or compression chamber, lubrication of all parts connected thereto becomes but a matter of turning a hand wheel, pressing a button, or pulling a plunger whenever necessary or as recommended by the builders, depending upon the construction and operating conditions involved. The amount of oil delivered at any period is restricted as nearly as possible to the theoretical lubricating requirements of the respective bearings. As a result, any such system is rightly classified as a "fresh oil" system, for normally there is no re-circulation of oil.

Since different bearings vary in regard to their lubricating requirements, dependent upon their size and duty, some arrangement to regulate or control the oil or grease flow is necessary. In effect, this amounts to metering the lubricant in terms of drops or globules. It can be accomplished either by proper individual construction of the drip plugs, or control outlets, by use of a control device located at the base of the pump, by installation of adjusting manifolds at salient points in the system, or by suitable measuring valves.

Where such systems are designed and installed properly they are exceedingly simple to operate. They also ensure that clean oil will be delivered to the respective bearings, for every precaution is taken to prevent entry of dust into such a system, just as in a pressure grease

lubricator. Often the central oil reservoirs are equipped with filtering media, such as felt pads.

All parts, however, must be of such construction as to withstand jars, shocks, and temperature fluctuations, for while piping, controls and fittings normally are guarded wherever possible, it is frequently impossible to protect all parts from the chance breakage, especially where bulky stock may be handled, as on a machine tool.

Mechanical force feed oilers function under the same principle as centralized pressure lubricating systems in that they also involve one-time or "fresh oil" lubrication. Oil is delivered, as nearly as possible, in the amount necessary to meet the actual lubricating requirements of the parts served.

Such lubricators are dependable, and decidedly economical, provided they have been installed carefully and are of such design as to permit a proper adjustment of the rate of oil flow.

It is practicable, of course, to drive a mechanical force feed lubricator by an auxiliary electric motor, or directly from the machinery which it is to serve. A distinct advantage pertains to this latter method, in that the lubricator functions only when the machinery itself is in operation, and then only at a speed proportional to the operating speed.

Where such a lubricator is driven in this manner, it automatically starts and stops pumping oil when the machine to which it is attached is started or stopped. This is an advantage inasmuch as it reduces the amount of attention necessary on the part of the operator.

It must be borne in mind, on the other hand, that the mechanical force-feed lubricator is subject to limitations, due to its relatively small capacity in contrast with the amount of oil which would be carried in a pressure circulation system. This also may entail more frequent refilling, dependent, however, upon the extent of operation, the rate at which oil is pumped, and the number of parts to be lubricated.

Mechanical force feed lubricators usually have oil reservoirs of a capacity ranging from one pint to two gallons. The pumping element or block is located within or attached to this reservoir. In general, the driving means is a ratchet, clutch or belt. Such oilers often have a number of pumping elements. This frequently makes possible the individual control of oil flow to each respective wearing part on the machine to be lubricated. It is feasible also to divide such a lubricator into two or more parts, so that different grades of oil may be used. In this case, however, it always is advisable to make sure that the right oil is put into the right compartment when the reservoir is to be refilled.

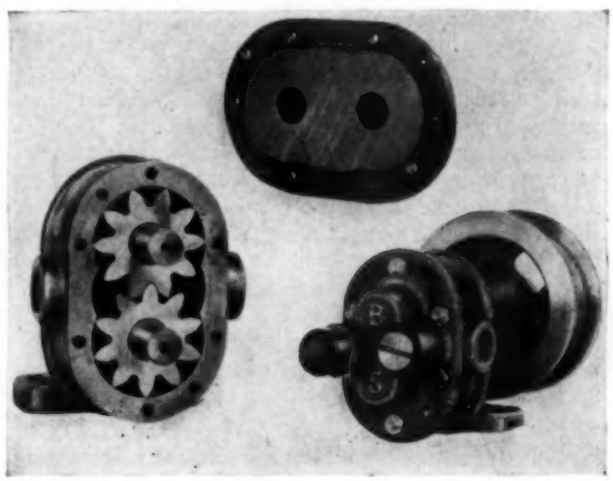
Piston and Plunger Pumps Used for Lubricators

As a general rule, the pumps employed in force feed lubricators are of the piston or plunger type. Actuation is by an eccentric or cam driven by an exterior operating mechanism. To enable observation of the rate of pumping and determination of the extent to which lubrication is being maintained, a suitable gage glass or sight-feed device can be located in the discharge line from the pump.

It is practical to use a mechanical force-feed lubricator for a wide variety of oils. In the case of an ammonia compressor, such a device might be called upon to handle an oil as low in viscosity as 100 sec. Saybolt at 100 deg. F. In contrast, a lubricator of the same type installed on a steam engine might be handling a compounded steam cylinder oil of 160 sec. Saybolt viscosity at 210 deg. F. In the industrial plant, it may be essential also to use comparatively heavy oils.

For these reasons mechanical force-feed lubricators often are designed to allow for preheating of the oil prior to delivery, especially if the installation may be exposed to atmospheric temperatures low enough to cause the oil to become so sluggish as to flow with difficulty through the pumping elements or feed lines. Preheating may be done by electric current or steam, according to the facilities available and the construction of the lubricator.

Grease lubrication can be accomplished by use of pressure, pumping action, or temperature fluctuation. If grease having characteristics suited to the type of lubricator is used, it is decidedly adaptable as a lubricant for many of the wearing elements of industrial production machinery. In many cases, however, it requires individual servicing of the parts involved in much the same manner as with the grease-lubricated automobile chassis. But this permits of the treatment of each bearing in accordance with its specific requirements, using more or less lubricant according to constructional conditions, bearing pressures and operating temperatures.



The gear pump is one of the oldest types of mechanisms for circulating lubricating oil. The one shown is made by Brown & Sharpe and is used on many machines

Considerable attention, on the other hand, is being given today to gang lubrication from a central point of control. Lubrication of this kind can be rendered automatic in many instances, according to the type of lubricating equipment and the amount of grease charged.

Pressure grease lubrication by any method whereby adequate pressure can be developed, commensurate with the consistency of the grease, is decidedly advantageous on parts in which bulky lubricators might be in the way, or whose motion is such as not to require too frequent application. Moreover, with the grease gun there is but slight possibility of the lubricant becoming contaminated prior to application if care is taken to fill the gun with grease free from dirt.

In practice, grease is put under pressure by:

1. Manual adjustment, as in the screw-down or compression grease cup,
2. Spring operation, as in the spring type lubricator in which a plunger is actuated by a spring, or

3. A power actuated plunger, which is operate electrically, by compressed air or by a hand or foot pump, involving screw or lever action.

Screw down types of grease lubricators are individual in operation. Frequently the pressure developed upon the grease is not as constant nor as dependable as in lubricators involving mechanical pressure. With the average type of simple compression grease cup, pressure is greatest at the time of adjustment, and depends upon the number of turns given the control handle or cap, the size of the spring—where one is used—and the amount it is compressed at the time of adjustment.

Spring pressure grease lubricators are more dependable and positive than hand regulated types. Devices in this class employ a spring-actuated plunger within a suitable cylindrical container or grease reservoir. Charging is accomplished by means of a pressure gun, which can be attached to a suitable nipple located in the filling channel at the base of the lubricator.

As grease is forced into the lubricator below the plunger, the latter is forced upward to compress the spring. In the usual construction the plunger rod is extended above the top of the lubricator. If properly calibrated, this rod serves as an indicator, showing the amount of grease below the plunger at any stage of filling or discharge. There is no necessity for removing the cover of such a cup. As a result, there is less chance that the grease charge will become contaminated with dirt, dust, or other non-lubricating matter which may be abrasive.

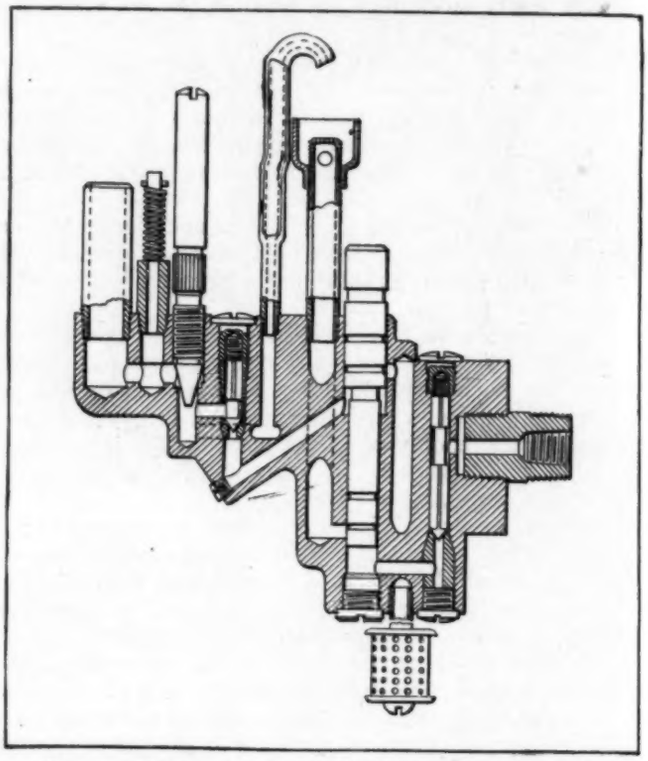
Pressure guns for filling grease lubricators also are used for direct application of grease to the bearing itself, or in connection with a central lubrication panel equipped with suitable nipples or fittings to which the gun or hose can be attached. When a central panel is employed, each fitting is connected to the filling channel of its respective bearing by suitable piping through which the grease is transmitted. With such an arrangement, the process of re-lubrication can be accomplished more rapidly and frequently more safely than when bearings are lubricated individually at the bearings themselves.

Initial pressure for the filling of grease lubricators can be obtained by manual operation, as in the case of the hand gun so familiar to the motorist, or by the use of compressed air, or electric power, according to the type of gun and the pressure desired.

It is important to remember that pressure as applied by the grease gun in connection with a spring-type lubricator does not react directly on the bearing; it must do work first in compressing the spring in the cup. After this, lubrication is brought about automatically by the pressure of the spring upon the plunger, which forces the grease into the clearance space between the bearing and shaft. By using a spring of definite tension in company with a valve of suitable design to conform with the consistency of grease used, flow of the latter can be controlled accurately.

Where the pressure gun, or so-called "power" grease lubricator, is used only in connection with a pressure plug or nipple, there is practically no reserve storage of grease, once the gun is disconnected. In other words, pressure is exerted on the grease only while connection with the lubricator is maintained. In consequence, the degree of lubrication may vary. Therefore, renewal of grease should be made at comparatively frequent intervals. Normally this requires considerable labor and also, perhaps, shut-down of certain machinery.

Some machinery, of course, requires grease lubrication under considerably higher pressures than can be attained through the average spring-type or screw-down cup. This is true especially where positive and com-



Pump mechanism of a Detroit force-feed oiler. The central plunger is actuated by a shaft driven from any convenient moving part of the machine that is to be lubricated

plete cleaning of bearing clearance spaces and oil grooves prior to re-lubrication is essential, as for example, where conditions of operation may be conductive to entry and accumulation of dust, dirt, or other non-lubricating foreign matter. Such foreign matter should be cleared from the bearing at each greasing, for otherwise excessive wear may develop. For this reason automatic delivery of lubricant is less important than adequate pressure. Direct application of grease by means of a power lubricator best meets such requirements.

The use of a power grease lubricator in almost any form requires a certain amount of manual handling. The lubricator itself must be moved. There is the flexible hose or connection to be handled, and fittings must be wiped clean before attachment of the hose or gun connection. Finally, the lubricator itself must be operated. All this requires time, care, and good judgment. The last, in particular, is essential in determining when a bearing has been cleared completely of used grease and sufficiently charged with new lubricant.

If properly carried out this method of lubrication is decidedly economical. On the other hand, should the operator be careless, unobservant, or continue the application of lubricant to an excess, not only will waste of grease occur, but there will be also greater chance of a sloppy condition around the bearings.

An indication of a properly lubricated plain bearing is a slight bulge of fresh grease at a bearing end. In this

regard, however, bearing construction and the possible use of sealing devices must be taken into consideration.

Pressure grease guns can be used either with or without hose connections, according to the type of fitting to which they are to be attached, or the location of the part to be lubricated. Pressure can be applied either before or after attachment of the gun to the fitting. In certain hand guns pressure frequently is developed by forcing down a suitable plunger by means of a threaded stem which screws into a bushing in the head of the gun. In other types of guns pumping action by means of the handle and a suitable pressure-retaining device is employed.

Where pressure is to be developed before attachment of the gun to the fitting, a suitable check valve must be installed in the tip. The valve opens automatically to permit lubricant to be forced to the bearing when the gun is attached to the fitting. An advantage of this type is that the necessity for relieving the pressure before detaching the gun from the fitting is eliminated. Moreover, it is practicable to raise the pressure before attachment, thereby reducing the chance of twisting off the fitting. These factors are especially important where grease has been allowed to remain so long in the bearings as to become gummed, caked and mixed with dirt. Full and positive pressure is essential in such cases, for the old grease must be "started" and completely expelled from the bearing clearances.

In the average hand-pressure or power-driven grease lubricator, pressures of from 1,000 to 10,000 pounds are readily developed. Such pressures are sufficient to handle effectively the usual grades of greases which are employed for lubrication of machine tools and other industrial equipment.

External Lubrication Usually Involved

As a general rule, external lubrication is involved regardless of how a bearing may be lubricated by grease. In other words, the lubricant is applied at an exterior point. This is interesting as a contrast to oil lubrication, for with the latter the use of a geared or plunger pump within a suitable oil reservoir permits of a self-contained and fully enclosed lubricating system. Frequently it is a decided advantage to have such a system, especially where there may be possibility of lubricators or fittings being damaged or broken off in the handling of stock, or where cuttings or abrasive foreign matter may have an opportunity to gain entry.

It is important to remember that any grease is only as serviceable from a lubricating point of view, as the oil which it contains. In other words, the soap content serves merely as a carrier for the oil tending to insure its delivery to the wearing elements. This oil, therefore, must be a carefully refined product with a viscosity, pour test and flash point commensurate with the probable temperatures involved and the pressures to be met.

Where comparatively high temperature and high pressure service prevails, greases should be compounded with oils of comparatively heavy body. As a rule, highly refined steam cylinder stocks possess the requisite viscosity as well as the high flash and fire point requirements.

Pour test is important where a grease is to be used under relatively low temperature conditions. There the pour test of the contained oil should be sufficiently low to preclude any possibility of congealment.

Regardless of service, however, the type of machine to be lubricated, or the means of application, greases should be compounded so carefully that they will remain as nearly as possible in their intended state of perfect mixture. In other words, separation of oil from the soap content should not occur, for this is likely to result in faulty lubrication, bearing troubles, and waste.

Method of Checking Drawings
Discussion

By W. Mardy

THERE is one important disadvantage in drafting offices organized in the manner mentioned on page 251, Vol. 70, of the *American Machinist*. When certain dependable men are set apart for whole-time checking of other men's work, too many draftsmen accept that as meaning they can take liberties with their own work. They know that each drawing will be checked and therefore argue that they need not trouble. This throws practically all of the responsibility upon one man's shoulders. It is not good for checker nor for the draftsman.

Sometimes, however, the management cannot be wholly freed from responsibility. Rush tactics are enforced that leave insufficient time for the drawing to be prepared carefully. That is really tantamount to setting a premium upon inefficiency. It is a "suicidal" policy. A drafting room mistake finds its condemnation in the tangible things of steel and iron.

It is well to insist that mistakes passing draftsman and checker shall be charged against draftsman quite as much as against the checked. The checker's job, too, should be made one, not only of responsibility, but of established status, so that the checker's word will carry weight. The checker ought to be able to insist that the draftsmen exercise ordinary care, so that the work of oversight may be as direct and straight-forward as such work can be. It is only the checker who knows what difference there is to his end of the business when a draftsman is careless. It often doubles the labor of checking.

Many men want a chief's job, but few a checker's.

Standardizing Drawing Sizes

By Harry Kupper

OWING to the diversity of the product, it is usually more economical for the jobbing shop to use the design or assembly drawing for shop reference than to make detail drawings for all parts, unless there are a number of machines to be made on one order, or there are repeat orders at frequent intervals. To lay out all design drawings to suit standard-size sheets of paper would require considerable time and planning on the part of the draftsman, which could better be expended upon the design of the machine. Another disadvantage in the use of standard-size sheets is that, in adapting the layout of these sheets, it is probable that the draftsman will choose views and a scale calculated more upon fitting the drawing to the sheet than upon showing the design to the best advantage for shop use.

Although the use of sheets cut to standard sizes may effect some saving in the purchase of paper and in the filing of drawings, it results often in poor economy in the jobbing shop engaged in building special machines.

A 10,000 to 1 Reduction Motion

By W. E. Sykes
Farrel-Birmingham Company, Inc.

THE device described, shown in the illustrations, gives a reduction of 10,000 to 1 with four gears of practically the same size. It is an external adaptation of the differential principle used in some chain hoists, and in the split worm-wheel device used in early engine-speed indicators. It has an advantage over the internal type in that there is only 1 tooth difference between the gears, whereas four to six is the usual difference in the former. The reduction is therefore from four to six times greater.

The assembled mechanism is shown in Fig. 1. The two gears *A* and *C* have four projections that engage in slots that run the full length of the four distance rods *E*, and are stationary as far as revolving is concerned. They have, however, a uniform progressive rocking motion, the amplitude of which is just sufficient to clear the teeth at one point while they are at full depth at 180 deg. from that point. This rotary "wobble" engages each tooth successively similar to ordinary bevel gearing, but owing to the slight angle between the two gears, a larger number of teeth are engaged at the same time.

The gear *B* revolves on ball bearings, and has 100 teeth. The stationary gear *A* has 101 teeth and in making a complete "revolution" it moves the gear *B* ahead 1 tooth, therefore, it requires 100 revolutions or oscillations of *A*, for one revolution of *B*.

The rocking movement or oscillation of *A*, is caused by the cam shown at *H* in Fig. 2, which runs against a corresponding ring *D* with a ball-bearing *K* between them. Inasmuch as the inclination of the gear *A* is the same as the rise of the cam *H*, there is no lost motion between the two, and the ball bearing between them reduces the friction losses. The gear *A* rocks on the S.K.F. radial bearing *M*, the inner race of which is a press fit on the shaft. Sleeves on either side of this inner race prevent end movement, hence the gear is held firmly on the shaft and always rocks from the same center.

On the back of gear *B*, and integral with it, is a similar cam *L*, which repeats the operation in relation to the stationary gear *C*. The sequence of movement is: The gear *A* in one hundred revolutions moves gear *B* one revolution, and the gear *B* in one hundred revolutions moves gear *C* one revolution, which in turn must make 100 revolutions in order to move gear *D* a single revolution. Two of these devices in tandem would give a reduction of 100,000,000 to 1, although gear *A* probably would be worn out by the time the last gear in the train had made a single revolution.

One drawback of the principle is that only very considerable reductions can be secured. If a twenty to one

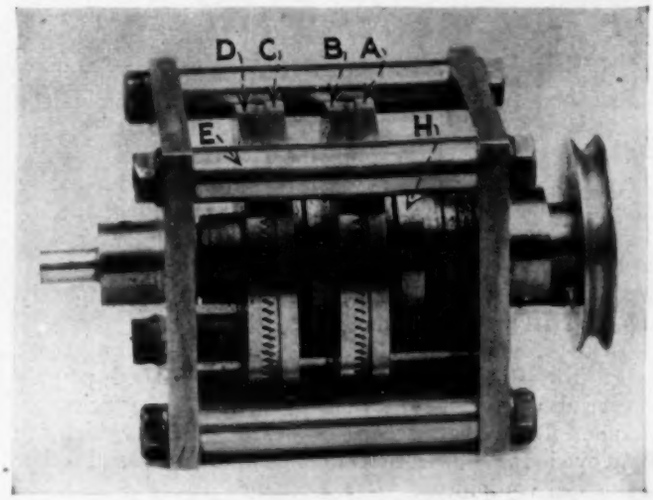


Fig. 1—A device with four gears and two cams that gives 10,000 to 1 reduction

reduction is required, which is the usual steam turbine reduction when transmitting 5,000 to 10,000 hp., the two gears necessary, would have 20 and 21 teeth respectively. This would require a different form of gear and tooth, one which would resemble a dental clutch.

The device should have many practical applications, however, not the least of which is to measuring machines. With gear *D* turning loose on a 40-thread shaft, and *A*, gear having a graduated disk, extreme accuracy could be obtained without being bothered with expansion and contraction, except in the threaded shaft. With such a reduction, lost motion could be entirely ignored.

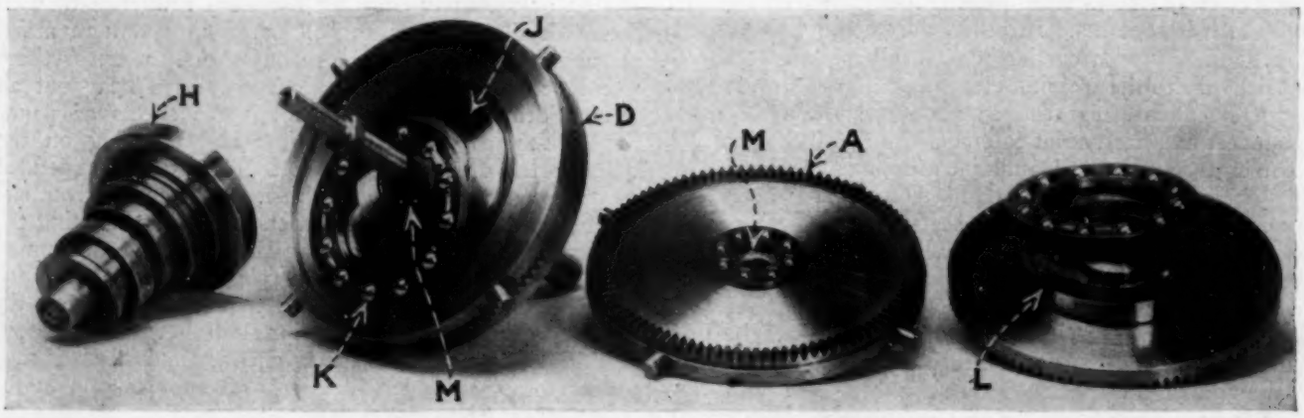


Fig. 2—Parts of the mechanism, showing the cams, gears and the projections that engage in the four distance rods and permit gears A and C to rock but not to rotate

A Twenty-Year Evolution in Bolt Head Trimmers

By Fred R. Daniels
The Waterbury Farrel Foundry & Machine Company

Modern machines handle larger sizes and greater variety of blanks automatically, while improved feed mechanisms prevent clogging

BOLT head trimming and cold heading, as methods of manufacturing bolts and other headed parts, have increased in favor in recent years, because both are economical processes of making bolt blanks and other headed pieces. The waste produced by turning bolts from bar stock is eliminated in the cold process. In addition, the cold process is much faster, and the finish of cold drawn wire is at least equal to that of a turned shank. If a good job is done, trimmed blanks require no subsequent finishing, although sometimes they are tumbled in water to smooth the sharp edges.

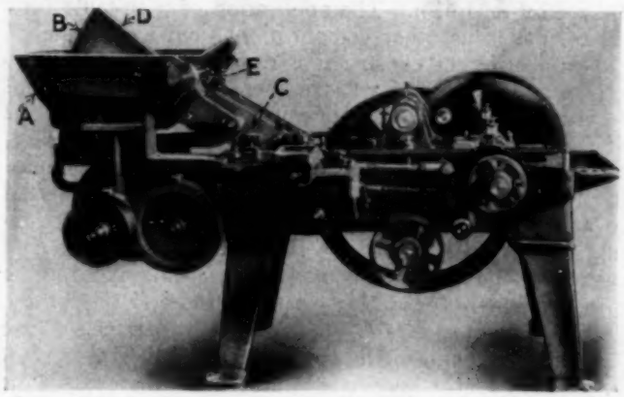


Fig. 1—An early design of horizontal bolt head trimmer which handled 45 standard ½-in. blanks per minute. This machine was superseded by that shown in Fig. 2 below

These factors have contributed to the growth of cold heading and trimming. The resultant demands for large quantity production have brought about continual changes in manufacturing methods and machinery, until it is now possible to trim standard ⅜-in. bolts, having shanks up to 4½ in. in length, automatically at the rate of 115 per minute. The production rate for ½-, ⅝- and ¾-in. bolts, the last being the largest size made by the cold process, is, of course, proportionately less.

Only a few years ago 60 per minute was regarded as good production for ⅜-in. blanks, and the automatic machines then employed were considered remarkable examples of efficiency, as they were when compared to the hand-fed trimming presses which preceded them. With the bolt head trimming press, production depended entirely upon the skill of the operator and seldom averaged more than 35 per minute for a ⅜-in. bolt. The blanks were inserted into a hollow punch attached to the press slide or gate, heads down, so that, as the gate descended, the head was forced down through the trimming die in the bed of the machine. Knock-out pins in the punch and die, both cam-actuated, ejected the trimmed blank during the ascent of the gate.

The excellent quality obtained by cold trimming led to the development of the semi-automatic horizontal trimmer, an early design of which is shown in Fig. 1. Machines of this type were employed quite generally about 1910; they were capable of trimming 60 ⅜-in. blanks per minute, 45 ½-in. blanks per minute and 30 ⅝-in. blanks per minute. The method of trimming with this machine was substantially the same as that employed with the vertical hand-fed press; that is, the punch was hollow and was held in the reciprocating gate, while the die was stationary in the frame. The punch telescoped over the shank of the blank, which was held horizontally, and pushed the head into the die. After trimming, suitable knockouts were employed to eject the blank from the die or punch.

One feature of this early design was the mechanical feed which employed a large hopper *A* into which the blanks were dumped, a swinging sector-shaped blade *B*, that moved upward through the blanks, and a chute *C*, leading from the hopper at an angle down to the transfer mechanism which carried the blanks to the tools. A removable strip *D*, slotted to suit the particular diameter of bolt being trimmed, was attached to the upper edge of this blade. The blanks were carried up in the slot as the blade ascended. In its uppermost position the slot formed an extension of the chute so that blanks that were seated properly in the slot slid down the chute to

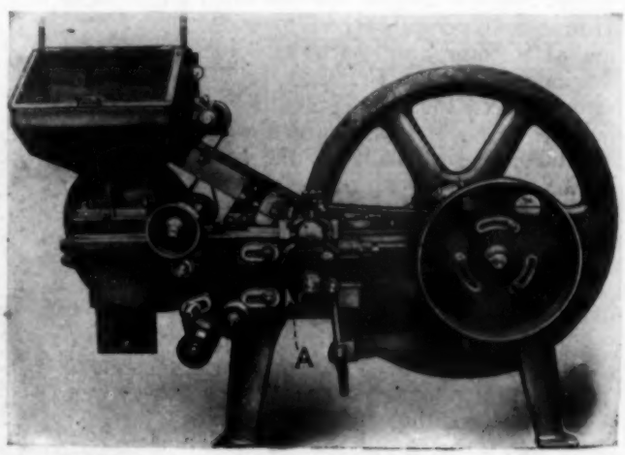


Fig. 2—This trimmer had automatic safety devices and in addition was simple to set up and operate. The hopper feed proved inadequate for blanks of certain kinds, and was discontinued in the succeeding machine

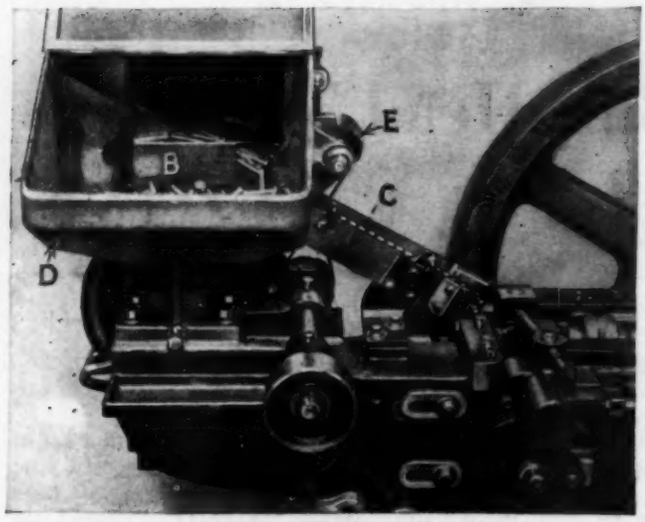


Fig. 3—A close-up view, showing the interior of the hopper and the vertically reciprocating lifter blade, as used on the trimmer shown in Fig. 2. The machine makes 65 pieces per minute

the transfer mechanism. Blanks that did not enter the chute properly were kicked back into the hopper by a revolving toothed wheel *E*, mounted outside the hopper just above the chute.

This feed proved satisfactory for a limited class of work only, since for long shanks it was incapable of keeping the chute filled, especially when the machine was run at maximum speed. Moreover, it soon became apparent that the demands for greater production required a more efficient machine, designed so that several could be run by one operator.

As a result, the trimmer shown in Fig. 2 was designed. This machine was rated at 65 per minute for $\frac{3}{8}$-in. bolts, 50 for $\frac{1}{2}$-in. bolts, and 35 for $\frac{5}{8}$-in. bolts. It was a decided improvement over the previous design and was capable of a much wider range of work, although rated for only slightly greater production. Features incorporated in this design included, not only a more efficient hopper feed, but also safety devices for automatically stopping the machine in case of trouble in transferring blanks of abnormal proportions or imperfect shape. These improvements made it unnecessary for the operator to give his undivided attention to each machine and permitted him to take care of a battery of machines. In addition, the hopper feed and transfer device were mounted in fixed relationship on an apron *A*, which was adjustable longitudinally on the bed for the purpose of expediting changing over from one length of blank to another. To make the change, it was necessary merely to adjust the apron, and transfer the timing and the chute, all of which could be done by an operator of average intelligence in about 15 minutes.

Fig. 3 illustrates this feed. A vertically reciprocating straight lifter blade *B* was employed instead of a swinging blade. This blade, in its travel upward through the mass of headed blanks, caught some on its upper edge and deposited them on top of chute *C*, which extended into hopper *D*. Eventually the blanks dropped into place, the excess and incorrectly located ones being thrown back by a clearing wheel *E*, which was of the same type used in the earlier design.

Difficulty still was experienced, however, in feeding, especially in the case of long blanks, which had a tendency to slide down on the top of the chute and lodge under the teeth of the clearing wheel, thus stopping its rotation and choking the chute. Short blanks with large heads also caused trouble, because they could not be carried up by the blade in sufficient quantities to keep the chute filled, but would topple off, due to the relatively greater weight of the head as compared to the shank.

Although this feed would handle blanks of average proportions efficiently, a hopper feed that was satisfactory for all combinations of lengths and head sizes had not been devised as yet. This fact discounted greatly the general adaptability of the machine for quantity production and led to the design of a rotor-feed machine.

It was found that the solution of the problem of feeding bolt blanks of various proportions—some long with small heads and others short with relatively large heavy heads—involved more than the mere redesign of the feed mechanism. The application of a suitable feed led to numerous other complications, and a machine of radically different construction resulted. This machine, known as the "rotor-feed" trimmer, is illustrated in Fig. 4. In its design the arrangement of tools and method of trimming was changed. The transfer device was relocated on the opposite side of the machine and the device itself re-designed, while the hopper feed was perfected so as to make possible practically 100 per cent production. Three sizes of these machines embrace the full capacity range, the production ratings being 115 for the $\frac{3}{8}$-in. machine, 80 for the $\frac{1}{2}$-in. machine and 65 for the $\frac{3}{4}$-in. machine.

In Fig. 5 is shown the construction of the rotor feed. It employs a large hopper *A* within which there is a rotor *B* having four or less blades *C*. This rotor is driven at a fixed speed by belt and bevel gearing. It agitates the blanks in the hopper and carries quantities of them up and onto the chute which extends into the hopper. The arrows in the sectional view indicates how this is accomplished.

At the chute outlet are two members, one of which,

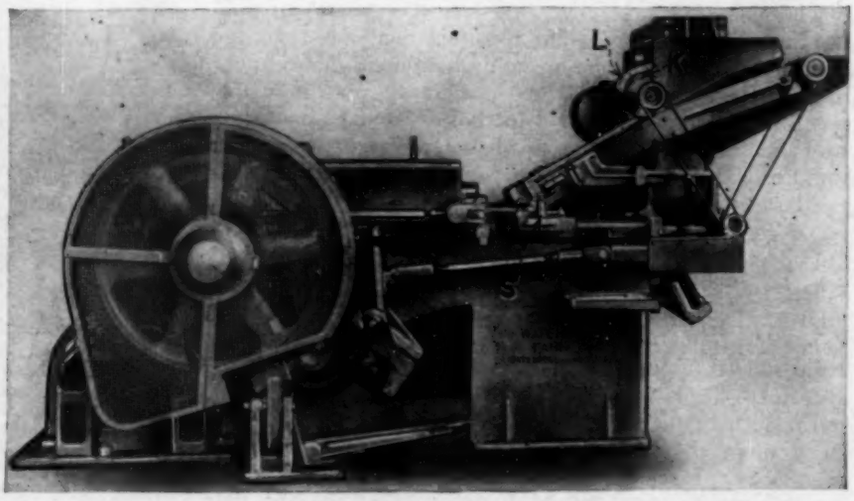


Fig. 4—A motor-driven trimmer of the latest design. This machine has a rotor-feed. Production is double that of the type shown in Fig. 2

marked *M* in Fig. 5, is fixed to the hopper, and the other *N* is adjustable by means of screws *D*, to vary the width of opening *E*. These two members are made with pockets for two long rolls *F* which are driven by helical gearing and belt *G*. The rolls are partly capped by steel liners *H*, which fit the curvature of the rolls, and have top surfaces tangent to the rolls. The revolving rolls eliminate the difficulty formerly experienced, due to blanks clogging the chute. With the new arrangement the blanks invariably locate themselves correctly between the rolls. The blanks then slide down under a clearing wheel of unique design and pass under cover *J*, which is adjustable for height of head, finally reaching the transfer device at the lower end of the chute.

Located just above the exit for the blanks is the clearing wheel, driven by belt and carrying two double-end pointed slides, or kickers, located on opposite sides of the wheel and at right angles to each other. One end of one of these kickers is shown at *K* in both Figs. 4 and 5. The radial movement of the kickers as the wheel revolves is governed by cam plates *L* which cause the points of the kickers to ride alternately along the top surfaces first of one chute member and then of the other, throwing the excess blanks back into the hopper and thereby preventing clogging. Those blanks which are properly located in the chute slide down between the kickers to the transfer mechanism.

The combination of paddle wheel rotor, revolving chute rolls, and kicker clearing wheel has proved effective in maintaining constant feeding for all sizes and classes of headed blanks. The wheel is adjustable for height, as well as in and out, to accommodate itself to all head sizes and shapes.

Instead of following the method previously employed, in which the blanks were pushed head first into the die, they now pass shank first into the punch. In this design the punch is stationary instead of moving and the die is attached to the reciprocating gate. The die pushes the entire shank of the blank into the punch until the underside of its head bears against the end of the punch, whereupon the trimming operation takes place. This arrangement not only trims, but at the same time straightens any blanks which are slightly bent and assures concentricity of head and shank. To permit these operations without jamming the blank in the punch, it became necessary, in designing the transfer mechanism, to provide for gripping the blank at the extreme end by means of spring fingers so that, when swung down into horizontal position, the end of the blank would be located directly in front of and close to the hole in the punch. As soon as the die has pushed the shank far enough into the punch to prevent it from falling out, the finger arm swings up, causing the fingers to snap free from the shank and out of the way of the advancing die.

Blanks are pushed one at a time from the chute into pocket blocks attached to the transfer slide *S*, Fig. 4, by a pivoted escapement finger. The escapement device is an entirely new feature in this machine. It not only forces each blank into the pocket block, but also holds back the column of blanks remaining in the chute while the slide carries the blank, cradled in the pocket blocks, over to the transfer fingers and is returned for another one. In previous designs, the last blank in the chute supported the weight of the entire column, a condition which often caused interference with the operation of the transfer slide. In the present design, spring fingers pick the blank out of the pockets, gripping it at the extreme end, while the finger arm swings it down to the horizontal position already described. This is a simple mechanism and functions at high speed. A spring safety device in the transfer drive automatically stops the motion of the slide if blocking occurs during the operation.

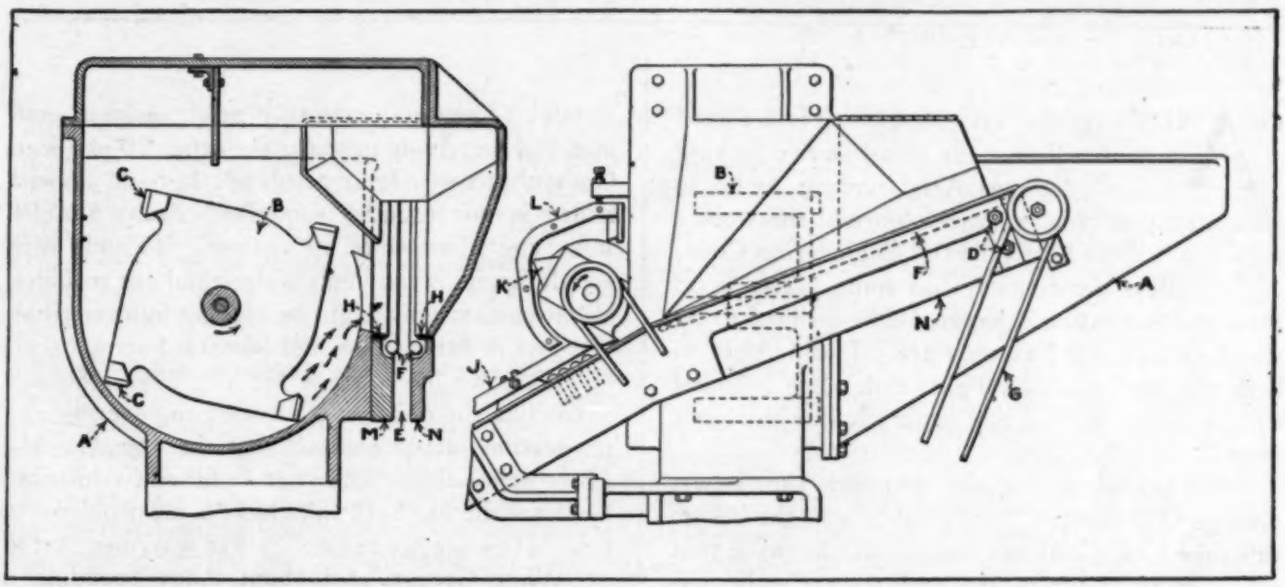


Fig. 5—Partial front elevation and sectional view of the improved rotor-feed used on the machine shown in Fig. 4

The crank motion of the gate provides a dwell immediately after trimming, during which the blank is ejected. Trimmed scrap, which is held between the die and punch while the knock-out operates, drops into a separate trough. Thus the scrap and work are separated automatically.

Friction and its effect on the life and service of machinery is still an open subject for much investigation. As long as engines with splash feed seem to run as well as those with force feed, we actually know very little about practical lubrication.

THE ENGINEERING C

The scene is a big contract production shop, consolidated also with an iron foundry and a nonferrous metal plant. It controls, also, a smaller shop that makes a specialty of contract production for the chain stores and mail-order houses. Conferences of the engineering and affected production executives with the chief engineer have grown into what the plant calls "The Engineering Council," which meets in a "council room" in the engineering department. Foremen are called in, and others drop

Who Should Design Patterns?

"ANDY says that cylinder casting is designed so it will give the results we're looking for," declared Art Levering, as he, in his capacity as chief engineer, opened the weekly parley which the boss calls the Engineering Council. "Unless the foundry has some pretty good reasons for wanting changes, I'd be inclined to let the drawings stand as they are. I told Andy to keep the sections fairly light, and, when it comes to a showdown, that boy generally has the right dope."

"'Generally' is right," growled the super, George Overman. "Only trouble with the design this time is that castings simply can't be made that way. Why, a lot of the sections are only one-quarter thick. Suppose a core slips a little, then where are we?"

"If you'd make the core the right way, George, it wouldn't slip," responded Andy Lines, the chief draftsman. "What's more, you go and part it the same as you did in the old design and get fins right where they'll do the most harm by preventing water circulation. Why not try some up-to-date methods? The Pourit Foundry turns out 50 tons of castings every day with lighter sections than our drawings specify."

"Yes, and you ought to see their scrap, even though they use nickel and other high-grade materials! They may make 80 per cent good castings, but somebody pays for the other 20 per cent. Guess that's why their prices are so high. Spend a day in our foundry sometime, Andy, and I'll show you what we're up against. Trouble with you designers is you don't understand our troubles. What you save in weight by making light sections, you lose in extra labor and increased scrap."

"Well, we haven't got far yet, boys. Sounds to me like the old battle between engineering and production departments," put in the G. M., Howard Hedley. "Why not declare an armistice? Looks to me like both sides have some problems to lick. How can we reconcile these warriors, Art?"

"What George said about Andy spending a day in the foundry set me to thinking. He can't spare much time outside himself, but I'll see that one of his best designers makes it his business to contact there and in the pattern shop as often and as long as necessary to get things running smoothly. I'll have him visit some other shops, also, along with one or two of George's men if possible, and see if all this doesn't bring about some changes that'll benefit everybody. Then perhaps we can design the patterns at the same time we're designing the castings. If that don't bring some improvements, I'll be greatly mistaken."

Should pattern work be left to the pattern shop or should the designer of the parts also design patterns and core boxes? What methods work best in practice?

GCOUNCIL

in. The problems are not solved for the readers, but some of the opposing opinions are brought out. Engineers and designers are invited to discuss the problem, or to present new problems for discussion. Acceptable letters are paid for at regular rates.

DISCUSSION OF COUNCIL TOPICS

Who Should Design Patterns?

WHEN new designs are coming through our practice has been to have intimate contact between the squad leader, in charge of the active design, and the pattern department. This gives the squad leader a working knowledge of pattern department methods. It has been felt that unless there is sufficient work to create and maintain separate a pattern design department, that this is the most desirable way of handling this work.

For the engineering department to design the pattern, as well as the piece itself, would mean that the designer should have as intimate a knowledge of foundry practices as he does of engineering design, which is practically impossible, as foundry practice is changing continually. For this reason, we think, in our own work at least, that the present method is a very desirable one. We have, however, very intimate contact with our foundry previous to completion of design, and we submit blue prints before the design is completely finished, so that the foundry may have an opportunity to study mold methods, and offer any suggestions that it may have for simplification of the design to facilitate manufacture.

—E. D. HERRICK, *Chief Engineer, Lycoming Manufacturing Company.*

IT IS the practice of the Taft-Peirce Manufacturing Company, and a good one, in the writer's opinion, for the engineering department to consider the making of the pattern, as well as ease in molding, while designing a casting. I believe it is advisable to have a man in the engineering department who is a first-class designer and pattern maker, and jobs of a complicated pattern-making and molding character should be assigned to him. We follow this method, and have obtained excellent results.

—N. E. BROWN, *Chief Designing Engineer, Taft-Peirce Manufacturing Company.*

IN OUR works, the practice is to leave the design of patterns entirely to the patternmaker. He has the drawing room to fall back upon if in doubt about details and he has the molder ever handy to consult as to the best parting. He also aims to aid the molder, to the best of his ability, by so constructing patterns that the molder will have the least labor and risk of failures. So, why tie a patternmaker's hands by asking him to work to a pattern designed by another?

The designer, the patternmaker, and the molder should be specialists in their respective lines. None of them should encroach on the other's field. Each should be held accountable for his own particular part.

—HENRY E. BILGER.

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Design Changes That Influence Sales

THE sales department should furnish complete data to the engineering department on the requirements of the users of the company's product. Salesmen should furnish information as to any difficulty experienced by the purchaser, and they should be made to feel that comments regarding conditions, whether in the form of praise or criticism, are sought and appreciated, and, what is of more importance, are heeded.

It is not conceivable that a sales department would expect to lay down definite, iron-clad specifications to be followed to the letter, neither is it advisable for engineers to attempt to design a machine without taking into consideration all available data. Close co-operation with the sales manager is an essential to the success of engineering as well as of sales. The sales manager should be big enough to separate the real troubles reported from salesman's alibis—too frequently resorted to when sales are not going well.

—ALLAN H. MESSLER, *Colt Patent Firearms Company.*

A CERTAIN Eastern automobile accessory plant I know about owes its rapid expansion chiefly to the efficient methods it uses in placing high-class products on the market. Design problems which tend to increase sales are considered paramount, and new ideas are welcomed from any source. The consumer is considered carefully when changes and new designs are put into operation, and competing products are studied, so that advantages, which they may have acquired, can be overcome.

In this plant the manager realized that success could be achieved only by following a policy whereby the consumer would receive a most efficient product at a reasonable price. His sales engineer, whom he placed in charge of sales, seems to sense beforehand what the consumer requires. His salesmen carry note books in which they jot down all ideas which retailers and consumers suggest, and pass these notes to the chief engineer at the end of each trip. If an idea proves valuable, and is incorporated into one of the company's products, the salesmen are rewarded with a suitable bonus. This has kept every man on his toes and there are many worthwhile ideas coming in from outside sources.

Engineers and draftsmen are allotted a certain number of points for each new idea which they suggest, and the sum of these points at the end of the year determine the increase in salary. All customers are invited to make constructive criticism on any of the products, and are welcome to meet the chief engineer or any of his aids at any time. The good will engendered by this practice is worth a great deal.

At the end of each month a general meeting of salesmen, shop foremen, and engineers is held and everyone is invited to join in the general debate, dealing with the betterment of the product. This plan alone has proved of

great assistance, and has helped to lower production costs, as well as to further the increase of sales.

When this company started in business eight years ago, only three small articles were manufactured, whereas now there are more than thirty-five, most of them resulting from the ideas of employees. If an employee discovers some new or improved type of product, which promises to be useful in the automobile world, the company takes it in hand, develops it, and pays the patent fees. When the article is placed upon the market, the inventor receives a suitable bonus and a small royalty. In this way, engineers and salesmen co-operate to make a product which meets the approval of the consumer, due consideration being given also to production requirements.

—FREDERIC A. J. SCHMIDT, *Industrial Engineer, Western Electric Company.*

THE question as to whether the sales department should expect the designers to meet its specifications seems to be mostly a case of whether the sales department knows enough engineering to prepare the specifications. In my sales trips, with products that require an engineering knowledge to understand, I have been surprised to find so great a difference between knowledge and title.

In one plant the greatest sales ability was found in the engineering department. The chief engineer was sent regularly on any unusually important job. Salesmen handled the ordinary work.

In another case I was trying to explain an engineering point to the chief engineer, when the president, a man who had reached his position through the sales department, but whom I think never had worked in any engineering department, joined us. He saw the point and told the engineer what was right. The chief engineer could figure stresses more accurately, but the president was a better all-around engineer than any man he had in his engineering department. At times I have found engineering and sales knowledge in the bookkeeping and accounting departments.

So the answer to your questions seems simple. That department which is most competent to prepare specifications should prepare them, regardless of its label.

—A. W. FORBES, *Forbes & Meyers*

THERE are many instances in which standardization of design has had a beneficial influence upon sales. One reason is that serious errors resulting from the correct use of standardized products are practically impossible. Again, standardization focuses attention upon meritorious designs and encourages their use in industry. It tends to eliminate waste of time in designing parts which require no originality, and thus gives the designer more time for the development and refinement of features still needing improvement. Standardization assures adherence to approved engineering practice. It is an economic benefit to any design. The sale of standardized products is usually less difficult than that of unstandardized products, for standardization tends to lower price, better quality, assure prompt delivery, and decrease the liklihood of the articles becoming obsolete.

To maintain sales volume sufficient to keep the factory working most efficiently, it is necessary to analyze the rate of turnover or outward movement of each article or part produced. Such an analysis generally shows certain articles turning over rapidly, and others selling very slowly. Elimination of the latter makes it possible to concentrate on items that move most readily. Thus distributors are provided with "live" numbers, easy to buy, and quick to sell. Greater concentration of sales on fewer items means a more effective sales force, and an intensified sales momentum, with consequent reduction in cost of distribution.

—HARRY KAUFMAN, *Public Accountant.*

TODAY, most of the larger concerns in mechanical lines promote men from their engineering force to their sales department, rather than employ salesmen who know little or nothing about design. This, in itself, is an indication that design has a pronounced effect upon sales, and that manufacturers realize the importance of having men who understand design in contact with their customers.

It is evident, especially under these circumstances, that the sales department is not overstepping its authority when it requests the engineering department to meet its specifications, for only by reasonable co-operation between all its departments can the success of a concern be assured. — MORTON SCHWAM, *Design Draftsman.*

IT MAY be said, with good reason, that sales are directly dependent upon engineering changes, since, of course, such changes furnish new material for advertising purposes and new subjects for the sales force to talk about.

When a company makes changes in its product, it frequently extends its sales into fields occupied by other products, the changes permitting the improved product to be used as a substitute that is either lower in cost or superior in quality. These changes, although often finding their origin in research, are in reality engineering changes made to increase sales.

Valve parts, turbine blades and nozzles, and similar parts were made originally of steel, followed by bronze. Monel metal was substituted for bronze, and was superseded recently by stainless steel. Many other examples of such changes could be cited. —R. M. SHERMAN.

WHILE automobile manufacturers doubtless turn out more new models for large production than any other makers of comparable mechanisms, they know the advantages of making new parts which are, so far as practicable, completely interchangeable with the old ones.

One prominent manufacturer in this field has carried this policy much further than others. He not only insists upon new parts being interchangeable with old ones, but takes pains to acquaint his customers with this fact by offering them parts of improved design to bring and keep their cars up to date.

This policy has certain disadvantages, however, the most important being the fact that, if the purchaser keeps his car up to date, there is less incentive to purchase a complete new car, especially when the construction is of such high grade that the car takes many years to wear out in normal service. Radical improvements also are difficult to make within the limits imposed by the old design. As a result the basic design is likely to become somewhat antiquated in comparison with competing products, in the manufacture of which a similar policy is not followed.

Thus, it becomes necessary to use discretion to determine when a new design shall replace the old one, especially where style has a pronounced influence upon sales.

—C. F. S. BURTON, *Automotive Engineer.*

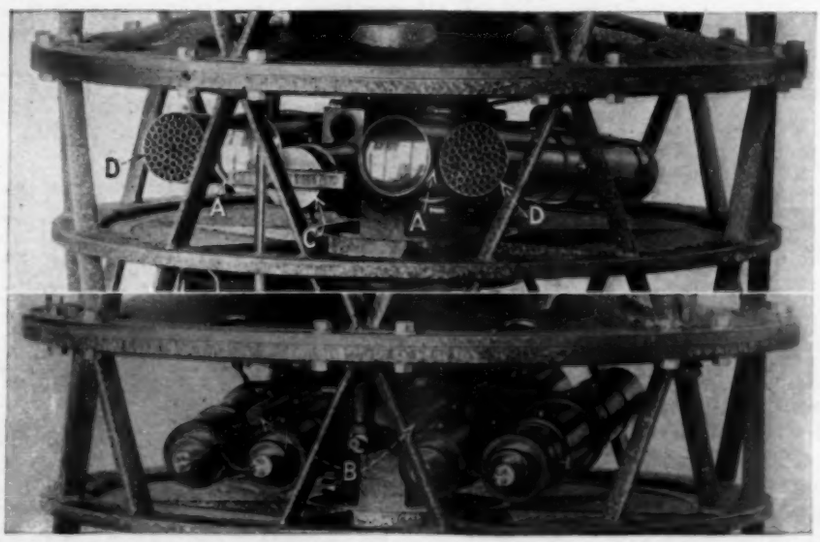
Design of the Zeiss Planetarium

A Complex Engineering Problem

By Henry Simon

Details of the sun and planet mechanisms, the orbital drive and the central body of the instrument—Problems in gearing

TWO VIEWS of the sun projector are shown in Figs. 18 and 19. The projector comprises no fewer than four distinct sets of optical units. Two pair, *A* and *A*, point in the same direction to produce, respectively, the sun and its halo. A third diminutive pair at *B* and *B* is mounted upon the rear end of the large pair and points in the diametrically opposite direction, to cause a faint luminous reflection of the sun upon the night sky. This reflection is at times visible in nature to a very keen eye, and, slightly emphasized in the Planetarium, it serves the useful purpose of indicating the position of the sun at any particular moment during the Planetarium "night." When the reflection is not wanted, the projectors are capped, and they are so shown in the illustration. Finally, at *C*, there is a central projector for producing the image of the phenomenon known as zodiacal light.



Figs. 18 and 19—Views of the sun projector from two angles. This projector has no less than four distant optical units. The two large pair point in the same direction. On top of this pair, a diminutive pair is mounted, pointing in the opposite direction

Though otherwise of the same general type as the planet instruments, the two outer solar projectors, it will be noticed, each have screen-like covers *D* over the objectives. These covers are composed of numerous pieces of small tubing, each about ½ in. long. Their purpose is to help cut up the relatively strong light from the instruments, to prevent any trace of shadows from the planet-cage trussing from being formed upon the disk of the sun and its halo. While the sun is the brightest of the bodies visible in the Planetarium, its light has been very greatly reduced before reaching the objectives to allow the stars and planets to become visible.

Regarding the motion of the sun it should be mentioned that the Planetarium must necessarily assume it to revolve around the earth as a center. In other words, it assumes the relative position of the sun and earth to be reversed, with the sun traveling around the earth's orbit once in 24 hours, as Fig. 20 shows diagrammatically. It will presently be seen that this reversal is entirely opposite from the case of the planets, in which the Planetarium reproduces the facts of nature in a strictly logical manner. It can readily be demonstrated, however, that no practical error can result from this hypothetical substitution.

While the most complicated as to its optical equipment, the solar projector is the simplest as to its mechanical features. Due to the practically central position of the sun in the plane of the ecliptic, or earth's orbit, all that is necessary to produce the desired effect is to cause the instrument to revolve around axis 2-2, which is accomplished by a spur gearing. Because of the fact that all of the solar-system instruments are at some distance from the geometrical center of the dome, a fixed angular correction, analogous to that discussed in connection with the fixed stars, in the previous article, Vol. 71, page 227, is necessary in every case. The optical axes of the projectors, therefore, are inclined, as will be seen in the diagram of Fig. 21, at a constant angle α to their planes or rotation. This angle is included between the lines indicating the axis of the sun instrument and the ecliptic.

A different condition from that of the sun exists in regard to the motions required for the five planet instruments. Their orbital planes are in all cases inclined at an angle of a few degrees to the ecliptic, this calling

The second part of the article. The third part will appear in an early issue.

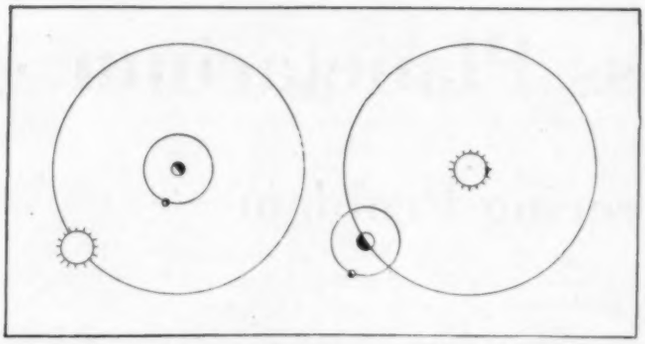


Fig. 20—Diagram explaining the assumption of the solar orbit in the Planetarium

for a corresponding tipping of their axes of rotation. The main difficulty, however, was introduced by the fact that each planet describes a number of apparent loop motions during each orbital cycle, as the result of the earth's overtaking, or being overtaken by, the planet. The way in which the illusion is brought about in nature, and the simple, and ingenious manner in which it is

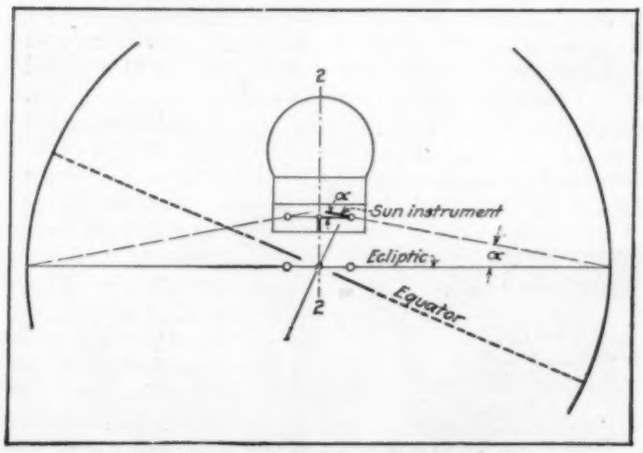


Fig. 21—Diagram showing the fixed inclination of the sun instrument

reproduced in the Planetarium instrument is illustrated in Fig. 22. The positions of the earth and a planet are compared with their positions in the Planetarium instrument. Note the constant angle α between the axis *I* of the instrument and the line of vision *V*. The lower diagram also shows how the apparent loop motions of a planet originate from the difference in the orbits and speeds of the planet and the earth. In this case the planet is moving more slowly than is the earth. The successive simultaneous positions of the two bodies cause the variations in the line of vision.

This solution treats the problem as if the ray from the projector were the line of vision from the earth to the planet. This is accomplished by imparting to one end of the instrument a motion corresponding to that of the planet it represents, and to the other end the proportional motion of the earth, both as regards time and relative size of orbit. By using means to keep the optical axis constantly aligned with these two pivotal centers of the instrument, the ray of projection is bound to trace a path upon the hemispherical-dome surface corresponding to the motion of the planet as it is seen from the earth. It will be plain that as in the case of the sun, the optical axis of the planet instruments must be tipped at a constant angle α to the line of vision, this angle depending upon the distance of the instrument from the center of the dome.

While in nature the planetary orbits are all elliptic, calculation showed that this difference was not such that any large error would result in the instrument from representing the orbit by a circle. A different situation was found to prevail in regard to the periodic variation in the speed of the planet.

This variation in speed is due to the location of the sun in one of the foci of the elliptical orbit. The diagram *A*, Fig. 23, shows that the speed of any planet is always such that the radius vector passes over equal areas in unequal times. The diagram *B* illustrates equal areas in equal times from the result of a plain, circular crank-motion. As the planet approaches the sun, it accelerates until it has attained its highest speed at perihelion or point of nearest proximity to the sun. Thenceonward it decelerates, until its speed is at its lowest at aphelion, or the farthest position from the sun. Calculation showed that while the variation could be ignored in the case of the other planets, it was large enough with Mercury and Mars to render it necessary to be taken into account.

How this acceleration and retardation was obtained with a very near degree of accuracy by the use of a uniform, circular crank-motion, is shown in Fig. 24 by means of the diagram. If a point *C* be constrained to describe a circular path while driven by an eccentric crank *D* revolving at uniform speed, it will travel along this path at a speed which will be periodically varying. Contrary to the case of the planet, this speed will be highest at the point farthest from the crank center, and vice versa. But it is necessary only to assume the opposite focus S_1 as the sun location, while still driving

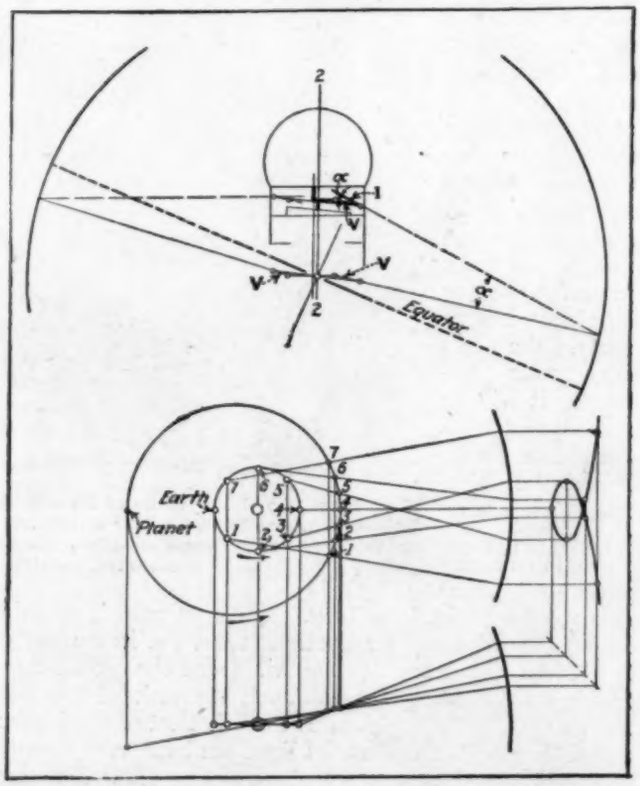


Fig. 22—Diagrams comparing the positions of the earth and a planet in the universe with their positions in the Planetarium instrument. Note the constant angle α between the axis *I* of the instrument and the line *V* of vision from the earth to the planet

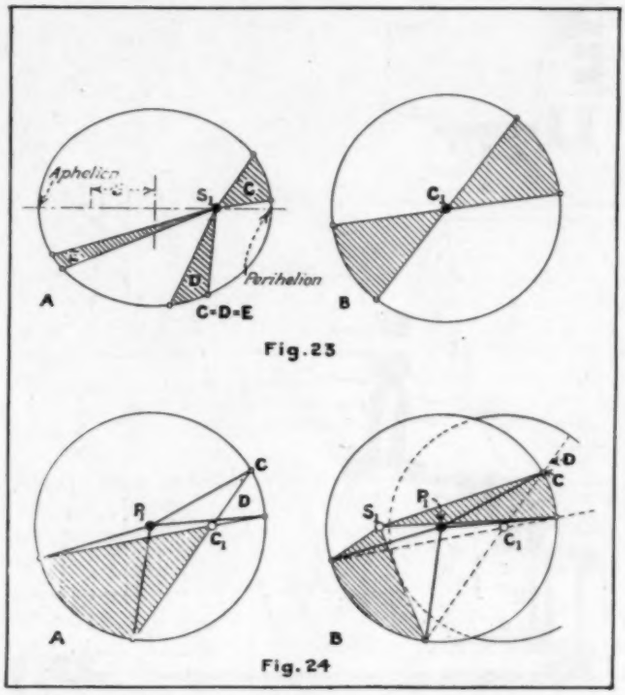


Fig. 23—*A*. Relations between the velocity of a planet and the area swept over by the radius vector. *B*. Equal areas in equal times in a plain, uniform, circular crank-motion. Fig. 24—*A*. Equal areas in unequal times by combination of circular with eccentric crank-motion. *B*. Approximation of equal areas in equal times by combination of circular motion with eccentric-crank motion around opposite assumed center of rotation

the crank from C in diagram A, to reverse this condition and obtain a variation analogous to that of the movement of the planet along its orbit.

In any such two-link drive, however, there would still remain a noticeable element of inaccuracy in the rate of retardation and acceleration. It was found, however, that the ideal approach to the truth could be obtained when, with the crank motion still taking place around P_1 as before, the movement of the pivot was governed, as in Fig. 25, by an intermediate link H having an axis H_1 located halfway between C_1 and P_1. This plan, though logically retaining the crank center at a point corresponding to the ellipse focus, decreases the error near the critical point. It will be seen from Fig. 26 why this is the point of "favorable opposition" or greatest

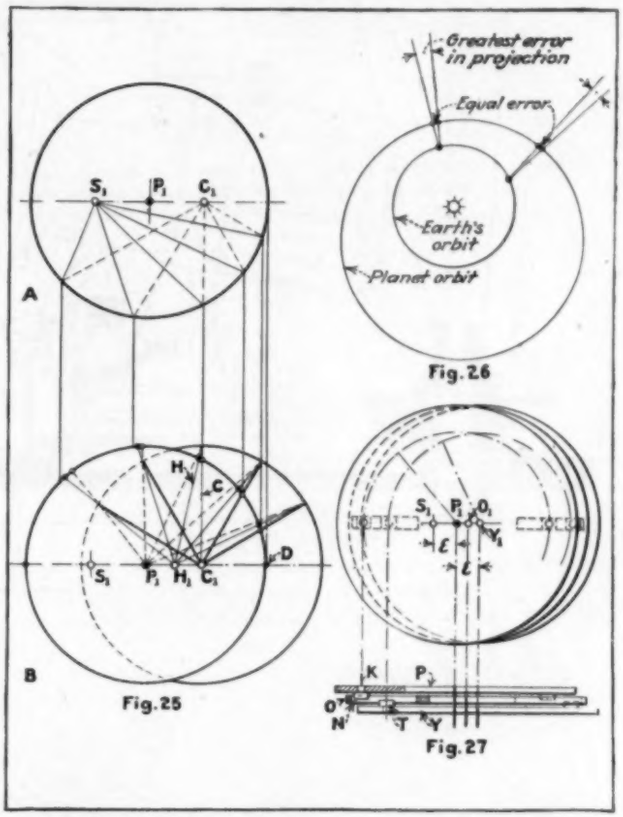


Fig. 25—Action of governor link on the motion in Fig. 24 B. Fig. 26—Diagram of orbital paths of the earth and a planet. Fig. 27—Diagram of the three-link motion in the mechanism of the planet drive

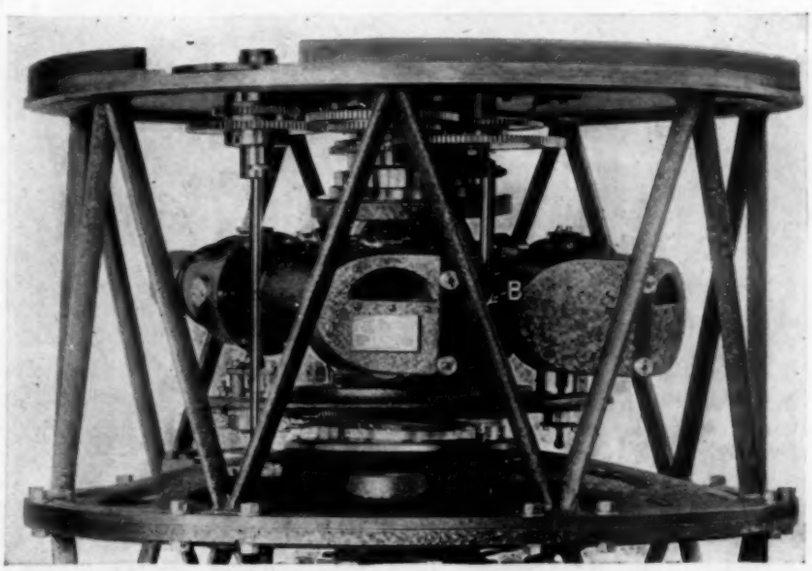


Fig. 28—The moon instrument and some of its numerous details. Although not complicated, the mechanism is of an unusual nature. It is an example of how a problem rendered difficult by optical considerations was successfully solved

proximity between the earth and the planet.

In accordance with the plan discussed, the orbital movement of the planet instruments is produced by the action of three separate members, all interconnected but each revolving around a different axis. The arrangement is shown in Fig. 27 diagrammatically, with the three centers of revolution indicated.

The pivotal planet-driving stud K of the instrument is mounted on a disk P, the center of which is the center P_1 of the circular "orbital path." This disk derives its motion from the engagement of a slide N in a radial slot located in a second governor disk O free to revolve around center O_1. The governor disk in turn is driven by the engagement, in the same slot, of a second slide T fast on a gear disk Y having Y_1 as an axis and constituting the last link in the planet-drive gear train. The axes of

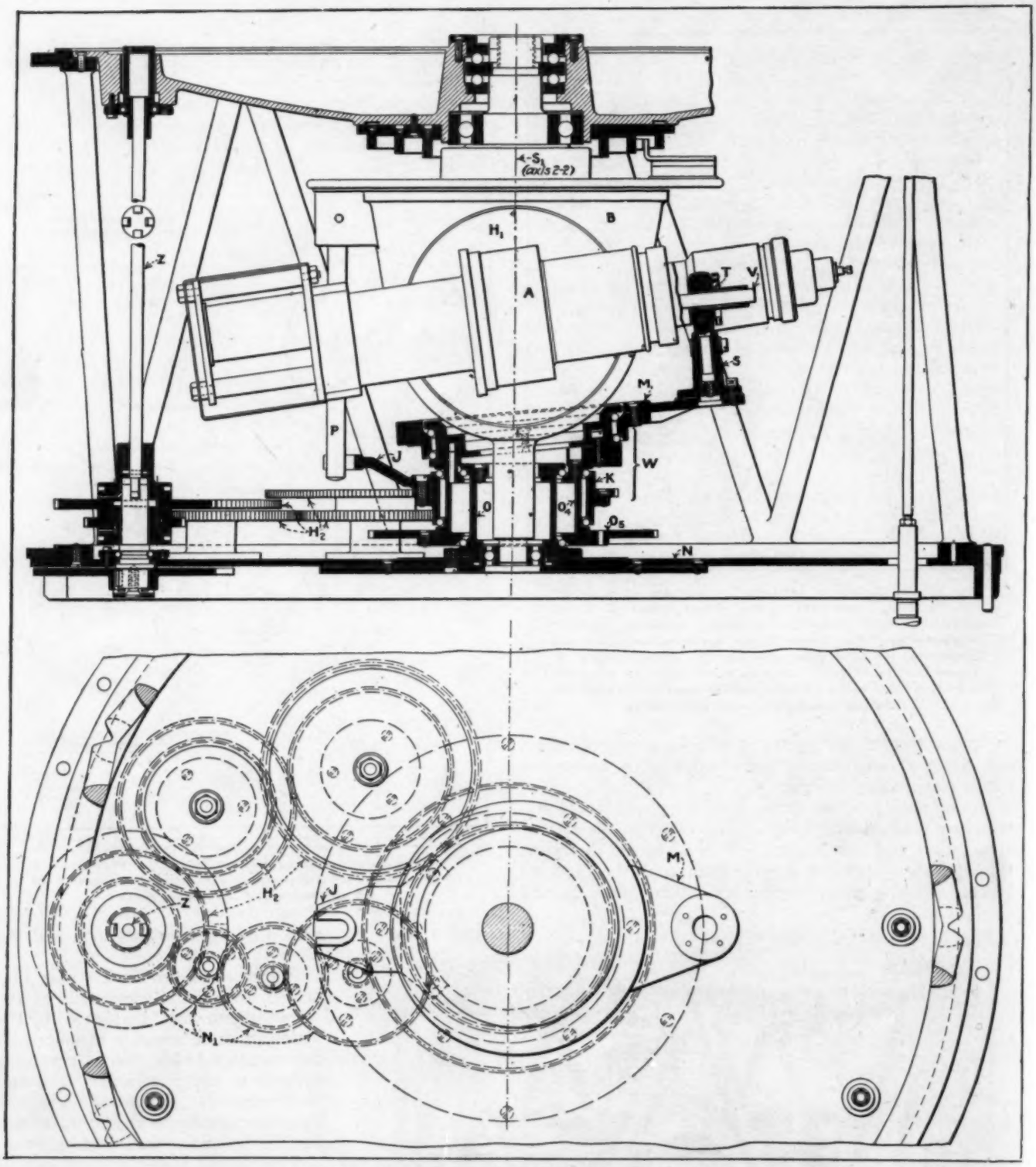


Fig. 29—Plan and elevation of the moon orbital-drive

all these three members are inclined to the axis 2-2 of the planet cage by the amount of inclination of the orbital plane of the planet to the ecliptic. The entire arrangement is offset by a distance equal to ε from S_1, which represents the sun and in the instrument coincides with axis 2-2. Axis 2-2 is therefore also the focal center for the terrestrial drive to the rear end of the planet instrument, which is located on the opposite bottom of the cage section accommodating it.

The planet-drive mechanisms for Venus, Jupiter, and Saturn are entirely similar to the terrestrial-motion mechanism, since the orbits of these bodies are also practically circular. The main difference between these planet drives and those for the earth is that their axes of rotation, besides being properly offset with respect to axis 2-2, must also be inclined to it at various small angles. The external difference between the three-disk and single-disk planet drives may be noted by comparing the Mercury instrument drive at the top in Fig. 17 with the Jupiter instrument at the bottom. The same views show a terrestrial drive in the Mars instrument.

The residual total error from the non-ellipticity and

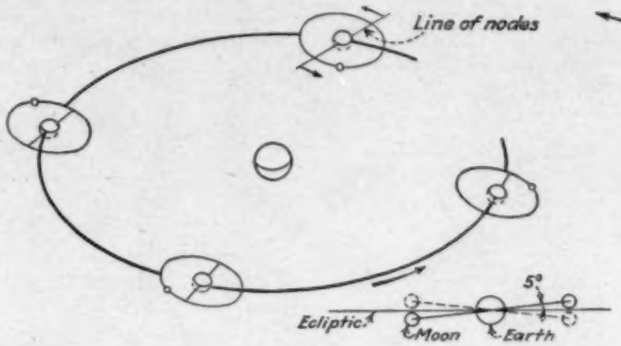


Fig. 30

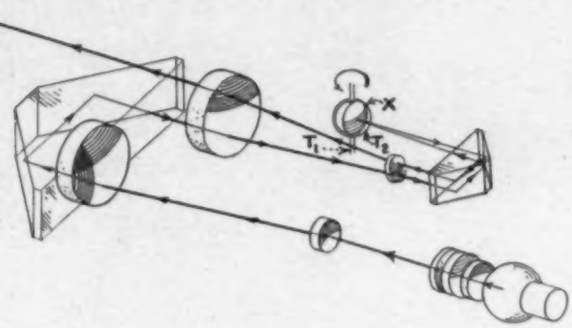


Fig. 31

Fig. 30—Diagram showing movement of the line of nodes. This line, or intersection of orbital planes, describes a circular movement once in 18.6 years. Fig. 31—Sketch of the optical arrangement of the moon instrument, showing some of the non-mechanical problems involved in the design of the Planetarium instrument

the difference in speed is of any noticeable extent only in the case of Mercury. The transverse and conjugal axes in the elliptic orbit of this planet are about as 1.00: 0.98. So near an approach to the requirement of "equal areas in equal times" is obtained by the mechanism which has been described, that the maximum theoretical deviation in the velocity of the pivot center representing the planet would cause an error of but 0.08 deg. The combined theoretical maximum error in projection on the dome surface, allowing for all causes, in both the planet and earth drives, is still less than 1 deg. As has been mentioned, this maximum error occurs near the moment of favorable opposition or nearest approach of Mercury to the earth, which happens in nature at somewhat irregular intervals on an average of once in about fifteen years. Still smaller errors obtain with respect to Mars, Venus, Jupiter, and Saturn.

It will be understood that the error above referred to is of a periodic nature only, and not in any sense cumulative. Special care was taken to exclude any appreciable positional error, such as might result, after a considerable number of orbital cycles, through inaccuracies in the driving-gear train. Some of the details of these planet drives are plainly to be seen in Fig. 17. Each of the sections of the planet framework carries its length of lineshaft *Z*, the shaft ends being joined by two-jaw couplings, and the entire shaft being actuated from the main drive of the instrument.

An unusual problem in gearing was presented by the fact that, contrary to practically all ordinary cases, the period of revolution of each planet-unit is an odd quantity in relation to every other unit. To give an instance, the time of revolution of Mercury as compared to the earth is as 0.415,209,106: 1. The problem was to find suitable gear trains that would produce a continuous motion so nearly correct that even in representing a past or future period several thousand years distant, the positional error would not be over a degree or so. At the same time, the diameter of the gears which could be used was closely limited by considerations of space, while for the sake of durability it was desirable that the number of teeth should not greatly exceed 100 in the largest gear used.

This end was attained by the help of continued fractions. In the case of Mercury, they gave a ratio of

$$\frac{3^3 \times 11 \times 43}{2 \times 7 \times 13}$$

which was raised by $2^2 \times 5$, to give

$$\frac{(3^3 \times 5) \times (3 \times 11 \times 2) \times (43 \times 2)}{(13 \times 5) \times (13 \times 7) \times (2 \times 2^3 \times 13)}$$

or the gear train, expressed in tooth numbers:

$$\frac{45 \times 66 \times 86}{65 \times 91 \times 104}$$

This ratio is within 0.00001 per cent of the truth, and would cause a difference in the position of the planet of only about 1 deg. after a number of revolutions corresponding to 5,000 years. With all remaining planets, it was possible to find gear trains giving results correct within even closer limits. All of these planet trains as well as those for the sun and moon projectors are driven at the rate of ten revolutions of the solar-system "lineshafts" for one revolution of the earth drive. Very little opportunity for error is thus introduced by the various gear trains in the instrument, in spite of the complexity of their design.

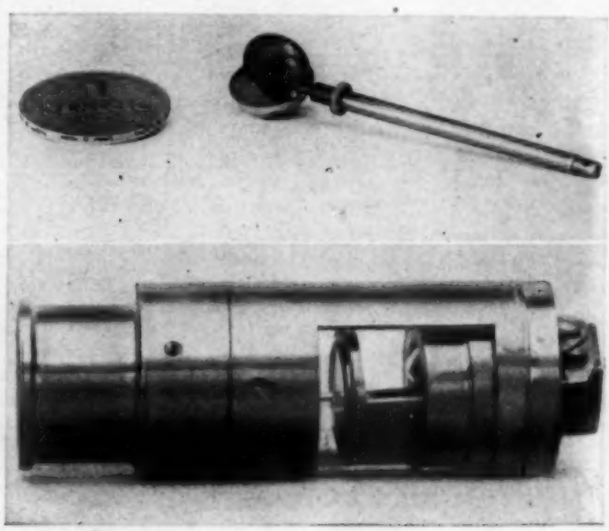


Fig. 32—Above, the golden mirror and the meniscus in the moon instrument. Below, one of the light stops

Of all the solar-system apparatus, the most interesting is the moon projector. Although the mechanism is not essentially complicated, it is of an unusual nature and constitutes an excellent example of cleancut handling of a mechanical problem rendered particularly difficult by

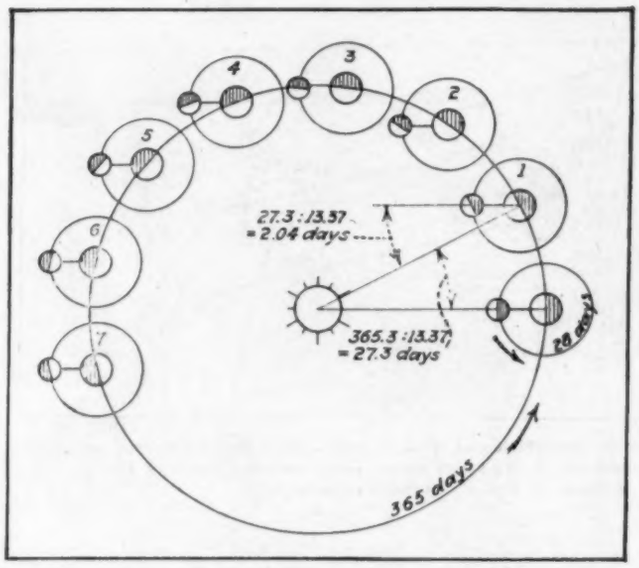


Fig. 33—Relation between the lunar month of 27.3 days and the phase cycle of about 29½ days

optical considerations. The view in Fig. 28 gives some idea of the general appearance and the numerous details of this body. In Fig. 29 the construction and the interior arrangement of the moon-orbital drive instrument can be seen.

Although the moon, revolving as it does directly around the earth, does not perform any apparent loop motions like the planets, yet it requires a more complex mechanism. This is partly due to the necessity of showing its various phases, and partly to the fact that in addition to being inclined at an angle of slightly more than 5 deg. to the ecliptic, the "line of nodes," or intersections of orbital planes, as shown in Fig. 30, describes a circular movement once every 18.6 years.

The diagram, Fig. 31, of the optical arrangement, will be of some interest even to a layman in illustrating some of the non-mechanical problems which had to be met in the Planetarium. Of particular interest is the ingenious double use made of a single system of lenses and prisms, their upper halves serving to transmit the ray from the source of light, while the lower portion returns the image from the reflector *X*. Reflector *X* is a slightly-concave hemispherical mirror, made in this case of an alloy composed of gold and silver. This mirror is held fixed in position upon a small radial pin T_1. The phases of the moon are produced by the rotation around this mirror of a delicate hemispherical cup or "meniscus" T_2 held on a shaft of which the axis coincides with the diameter of the mirror as well as that of the cup. An idea of the shape and size of the parts may be had from Fig. 32, which also shows one of the light stops used in this instrument.

As the instruments are doubled, it follows that there are two such arrangements, the synchronous rotation of the meniscus shafts being derived from planetary gearing of which the meniscus-shaft gears form the last link. The rotation of each of these gears is over an intermediate gear on the revolving instrument frame, and is derived both from the revolution of this intermediate gear around a central sun-gear and by the revolution of the central gear itself.

The motion of the central gear corresponds to a terrestrial year, and is derived from the adjacent sun-instrument, the gear being located upon an axial-shaft extension of the sun body. As the meniscus gears are equal in diameter to the central sun gear, they revolve once for every revolution of the instrument, corresponding to a lunar month of 27.3 days. The combination of the two movements produces in a simple and logical manner the difference of approximately 2.04 days existing between the lunar month and the phase cycle of about 29½ days which is aimed at by the average calendar month. In Fig. 33 the difference and the manner in which it arises is visualized.

The meniscus gear-train is mounted on a platform on the instrument body. Rotation of the instrument is effected in a way similar to the planet instruments, and in a plane inclined to the ecliptic, but with the difference that this inclined plane is also in rotation at the slow rate of 1.5 deg. for each lunar cycle, to account for the change in the direction of the line of nodes above referred to. When, with the net of reference lines projected on the artificial sky, the machine is continuously run to review a year in 7 sec., the moon is visible as a streak of light traversing the heavens in about ½ sec., and it is interesting to watch how the point of intersection of its orbit visibly creeps along the line of the ecliptic from west to east.

This combination of effects is brought about by rotating the instrument in its frame around axis 2-2, in Fig. 29, while rocking the instrument in frame *B* by the action of an inclined-plane body *W* which is in turn rotating upon its base. The instrument and inclined plane are driven from the lineshaft *Z* by separate gear trains. Train N_1 slowly revolves the inclined base, while train H_2 imparts the "monthly" motion to the instrument by a forked dog *J* fast on a gear on the inner train and engaged by a pin *P* projecting from the instrument frame.

Body *W*, in Fig. 29, is composed of five members, of

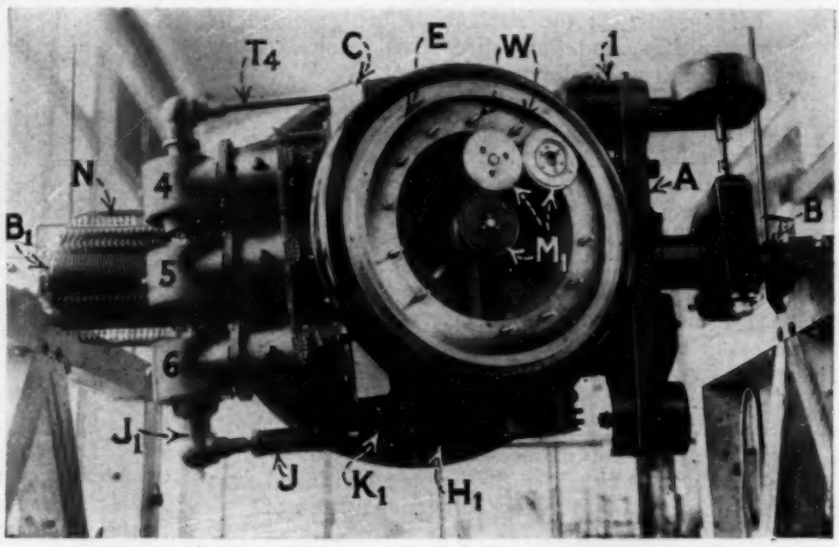


Fig. 34—North end of the main central-body of the moon instrument. At the extreme left are the three "annual" motors. At the extreme right are the motor and the double-worm drive for revolving the instrument around the horizontal axis

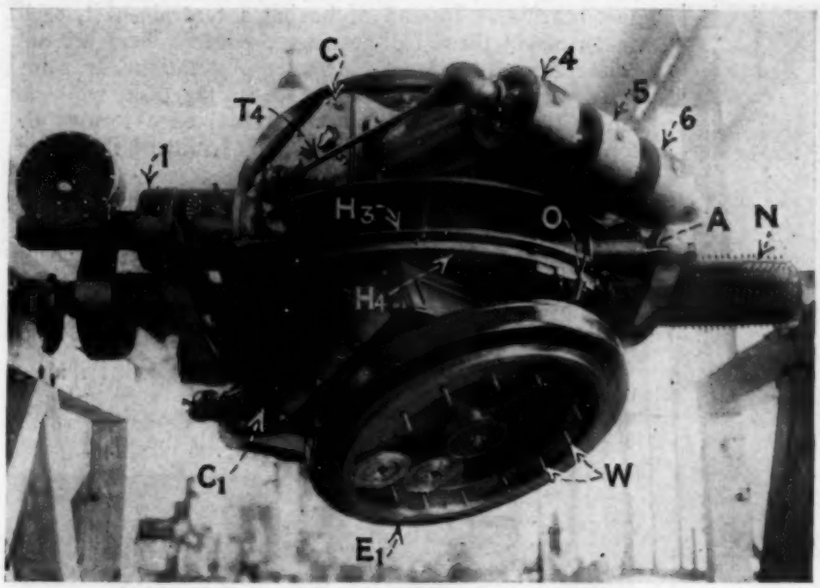


Fig. 35—South end of the main central-body of the moon instrument. The studs projecting from the face of the lower flange are electrical connections for the solar-system cages

which the central one O_4 has its bearing in a hub O on the planet cage partition, and in turn furnishes the bearing for the annular gear body K of the orbital drive. O_5 is the last link in the gear train H_2 which revolves the inclined base assembly. The wabbling motion of the inclined surface of W as it revolves is communicated to the instrument proper by the action of the flat body M. M is free to revolve around the inclined upper end of W, and by a stud S carrying a universal joint T, engages the direction rod V on the instrument and thereby rocks it once for every revolution of base W and in every 18.6 orbital cycles. The intersection point of the moon's orbit travels from west to east along the line of the ecliptic.

The lineshafts that drive the planet mechanism are terminal branches of the gear train, which is centralized in the main body of the instrument. The principal parts of this body are a roughly rectangular flat frame A, Figs. 34 and 35, pivoted at each end upon a horizontal axis B, B_1, and flanking it on either side are primary electric-current distributors H_3, H_4, the two halves C, C_1 of the main driving unit containing the gear train and bearing six motors, and the terminal flanges E, E_1 of the precession shaft, D Fig. 39, the axis of which is the axis 2-2, and upon which the two main projector assemblies are mounted. The complete body is shown in Figs. 34 and 35, and the main skeleton parts are seen in Figs. 36 to 39, in the order named.

Motion around axis 3-3 does not correspond to any sidereal movement, serving as it does merely to adjust the instrument to any desired geographical latitude. Accordingly, this motion has no reference to the remaining motions 1-1 and 2-2, for the diurnal and precessional movements, respectively. Rotation around axis 3-3 is obtained by means of a special motor on the central frame driving a worm around a stationary worm gear keyed to one of the two pivotal axles, which are fixed in the head ends of the trussed framework of the carriage. When the motor is turned on, the worm slowly revolves around this gear, thereby carrying the entire instrument around the horizontal axis once in seven minutes, as previously explained.

The motions corresponding to the real and apparent sidereal movements are relative to the pivotal frame, and are derived from six motors fixed upon the main gear case. Two of these motors revolve the entire instrument around axis 1-1 by acting upon a large bevel gear fast on the central pivotal frame, thereby producing the diurnal movement. The three motors for the annual movement, on the other hand, exercise no influence upon the motion of the main body, but serve to revolve the solar-system lineshafts. All of these five motors, however, are at all times also in gear with the precessional motion. Whenever any one of them is running, therefore, it also revolves the entire projector-carrier assembly slowly around 2-2, which is the long axis.

A seventh motor, acting directly upon axis 2-2, is provided for the independent rapid motion of precession. As just mentioned, this motion is always going on whenever the diurnal of annual movements are taking place. When produced by way of these movements, however, the motion is so exceedingly slow as to be imperceptible. Even when the entire year is run off in 7.3 sec., a difference of only about 7 deg. in the position of the pole

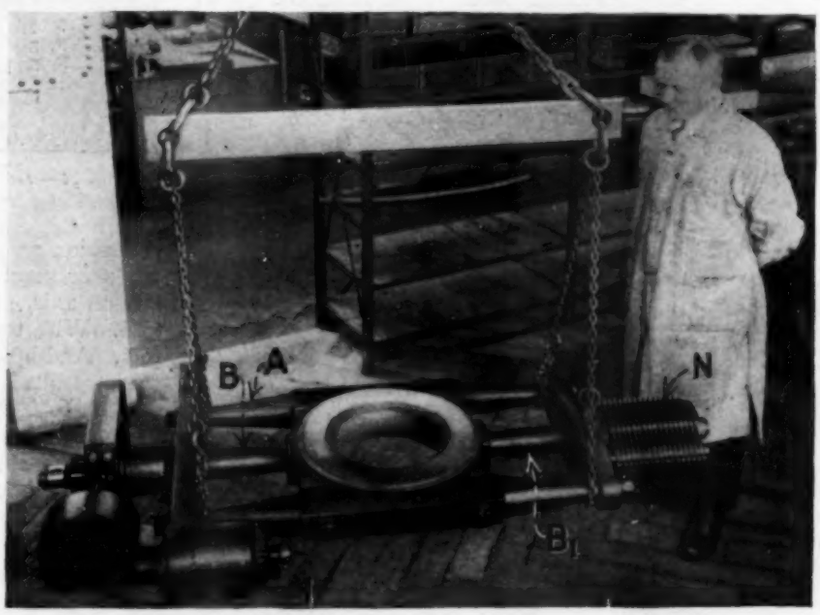


Fig. 36—Pivotal frame of the Planetarium machine. The axles B and B, are stationary, the body A being revolved around them when the heavens are to be shown in a new geographical latitude

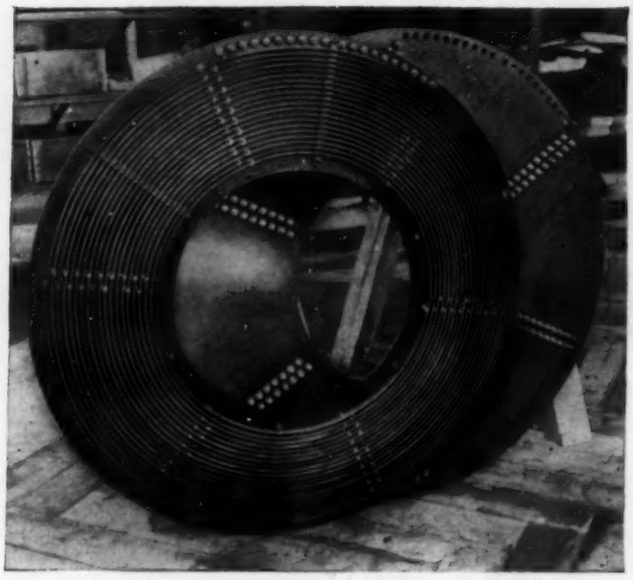


Fig. 37—Main electrical-current distributors

star would be noticed after the motor had been running a full hour. By means of the independent precession drive, the instrument is revolved purely around axis 2-2 once in 1½ min., thereby giving an impressive spectacle of the changes brought about by the gyratory motion of the earth once every 26,000 years.

The terrestrial planet instrument drives, though differing as to details, are the same for all five planet instruments, and cause the synchronized rotation of the rear ends of the instruments. Because of the small ellipticity of the earth's orbit, it was possible to represent it by a plain, circular, crank motion. The terrestrial motion mechanism, therefore, consists in all cases merely of a large gear having an axis offset from axis *2-2* by the eccentricity of the terrestrial orbit, and bearing near the periphery a universal pivotal joint supporting the rear end of the instrument. In this arrangement the planet and earth locations seem to be reversed. This reversal applies only to the instrument proper, and is done for practical reasons in the case of the interior planets.

A mechanical detail of interest is the design of the

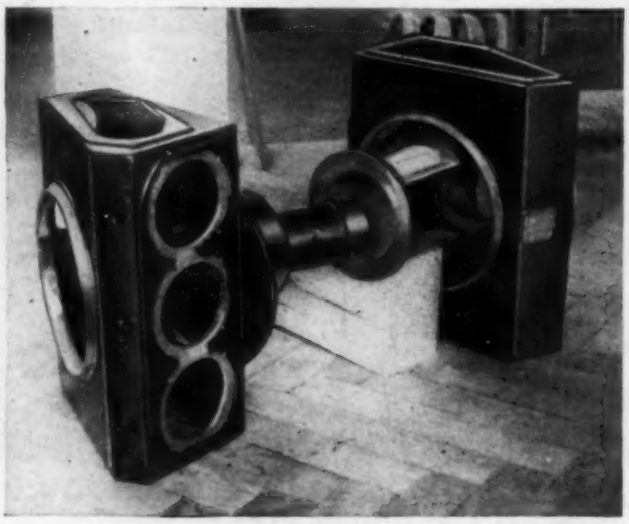


Fig. 38—Main gear-case halves and connection

disk bearings. Instead of having a central shaft, each disk runs in three ball-bearing V-edged rollers set out as far as possible from the center of rotation. In some cases they engage the outer edge of the disk, while in others they are applied to an internal edge formed by converting the disk into a flat ring by removing the major part of the central area.

As all of the terrestrial mechanisms are identical as to axis and rate of revolution, each two of those in the South cage are arranged back to back and are driven by one train of gears. To this end, each pair of gears is connected by a central hub passing through the cage partition.

The driving mechanism and some gear trains in which the gear reduction is enormous are taken up in the next part of the article. These gear trains are used in driving the five motions having to do with the annual and

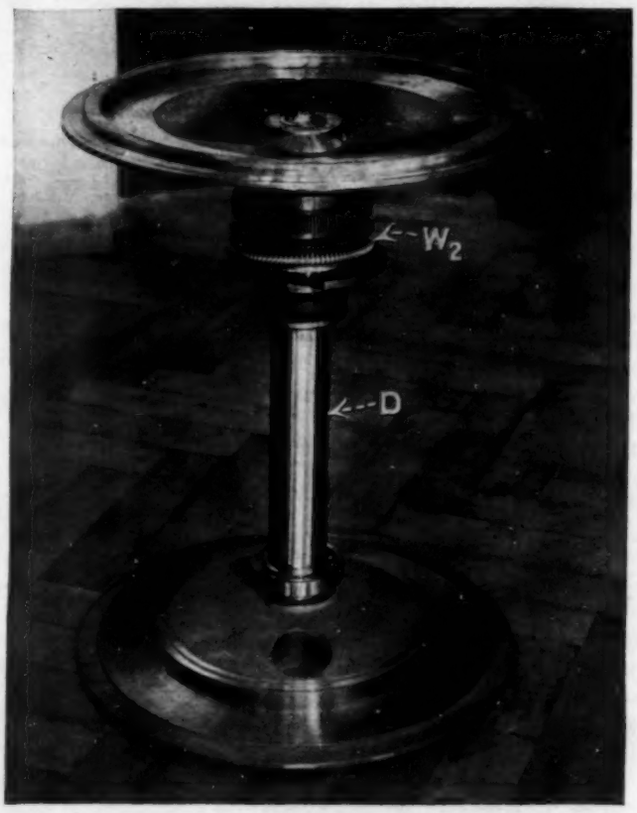


Fig. 39—Precession-shaft assembly with terminal flanges at top and bottom

precession mechanisms. They are undoubtedly without any near precedent. The smallest reduction to the precession axis, from the fastest yearly motor, is 4,320,000 to 1. With the slowest motor, this rises to 145,500,000 to 1. And by the roundabout drive of the diurnal motor, there results a stupendous reduction, in exact figures of 53,192,797,080 to 1. With the motor making 1,380 r.p.m., it would have to run day and night for 74 years before the instrument had revolved around axis *2-2* once! Although the precessional movement resulting under this last-named ratio is logically correct, it is plain that any such gear reduction cannot be more than incidental. It results in connection with the diurnal motion, not because it is desirable to have the precessional motion going on simultaneously with it, but because the movements of the solar-system bodies must be taken into account coincidentally in operating the instrument.

Service Characteristics of Light Alloys

By E. H. Dix, Jr.
Metallurgist, Aluminum Company of America

ALUMINUM and magnesium are the lightest commercial metals. These metals are relatively soft and weak in the unalloyed state, hence their application is somewhat limited. Aluminum sheet of 99.0 per cent purity can be hardened by cold-working so that it possesses sufficient strength for certain applications. The addition of 1¼ per cent of manganese increases the strength and hardness. This alloy, in sheet form, has been used extensively for cooking utensils and, because of its corrosion resistance, which is equal to that of commercially pure aluminum, should find useful application in aircraft construction.

Heat-treated aluminum alloys are of great importance, for they possess mechanical properties comparable with those of structural steel. But since the modulus of elasticity of aluminum and its alloys is approximately one-third that of steel, it is necessary to use somewhat thicker sections than the relative tensile strengths alone might indicate. For this reason, aluminum sections generally weigh about half as much as equivalent steel sections.

Commercial aluminum contains small percentages of iron, silicon and copper. While these elements are referred to as impurities, they actually are valuable alloying additions and appreciably increase the strength and hardness of the material.

A majority of the aluminum castings produced in this country have copper as the principal alloying constituent, and aluminum-copper alloys containing 4 per cent of copper form the base of the most important heat-treatable alloys. The alloy called Duralumin contains from 3½ to 4 per cent of copper and, in addition, a ½ per cent each of magnesium and manganese. In this alloy, the magnesium forms with the silicon, which is present as an impurity, the compound Mg_2Si. This compound and the aluminum-copper compound, $CuAl_2$, are the effective constituents in the heat-treating process. Manganese in the Duralumin-type alloy has a beneficial effect in raising the strength. Silicon is used extensively as an alloying element for casting alloys. These alloys have the particular advantage of having good corrosion resistance and of being easy to handle in the foundry. They show less tendency than others toward shrinks, draws, and cracks.

An alloy that is rather popular in England and, to an increasing extent, in this country, contains 4 per cent of copper, 2 per cent of nickel and 1½ per cent of magnesium. It is used extensively for pistons and air-cooled cylinder-heads. The more common alloy employed in this country for such purposes contains 10 per cent of copper, 1½ per cent of iron, and ½ per cent of magnesium.

In the magnesium-base alloys, aluminum and manganese are the most important alloying elements. Aluminum is used up to 12 per cent and produces alloys which are susceptible to heat-treatment. The addition of a small quantity of manganese to the magnesium-aluminum alloys is beneficial. One of the useful magnesium alloys contains 7 per cent of aluminum and 0.4 per cent of manganese. As sand cast and heat-treated, this alloy shows a tensile strength range of 29,000 to 38,000 lb. per sq.in., with an elongation range of 10 to 6 per cent. It is used for certain starter housings, motor cover-plates, pump housings, gearcases and covers, intake manifolds and sections of crankcases. These parts usually are heat-treated, but not always, depending upon whether the additional strength produced by heat-treatment is required.

For rolled sheet, plate, or bar, pure magnesium or an alloy containing 4 per cent of aluminum and 0.4 per cent of manganese are used. The tensile strength of rolled magnesium is approximately 25,000 lb. per sq.in., and the elongation about 4 per cent. By annealing, the tensile strength is lowered several thousand pounds per square inch and the elongation is raised slightly. The "as rolled" alloy, in the form of relatively thin sheet, has a tensile strength as high as 42,000 lb. per sq.in. and an elongation of 6 per cent. Annealing lowers this tensile strength to 37,000 lb. per sq.in. and raises the elongation to 22 per cent.

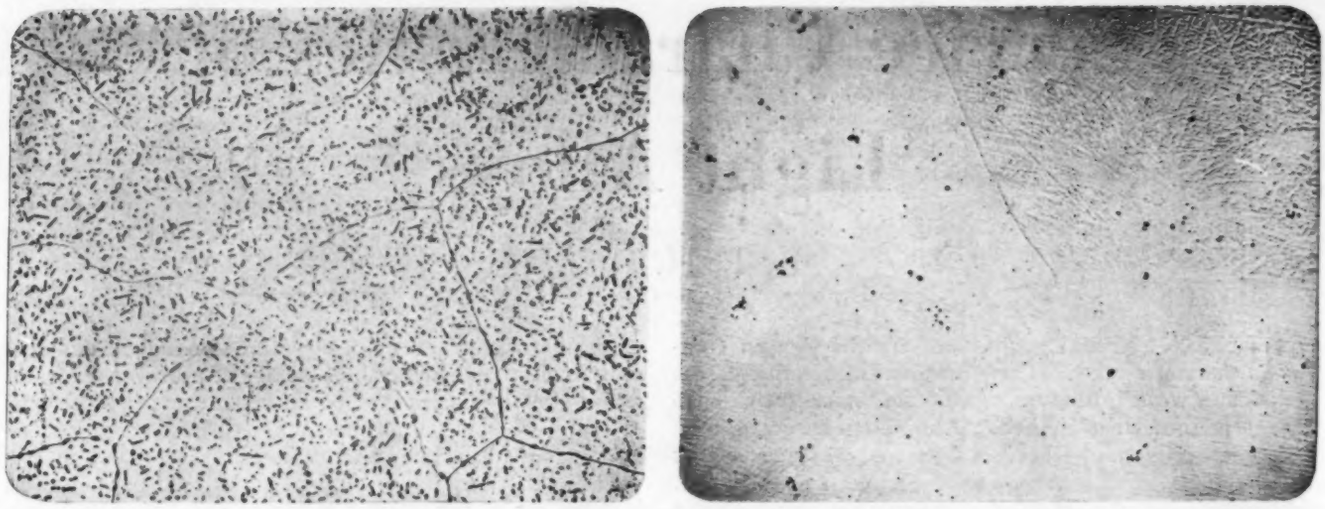
Heat-treatment and protection against corrosion extends the field of application of aluminum and magnesium products. The author gives much data useful to designers and metal-products manufacturers

Both pure magnesium and the alloy harden rapidly during cold-working, and it is often necessary to anneal between forming operations. The annealing temperature is 660 deg. F. The material can be worked at this temperature without hardening, and this is perhaps the most satisfactory way to form the material.

A very marked difference in mechanical properties exists between aluminum-copper alloys slowly cooled and those rapidly quenched. The former is in the soft annealed condition and the latter is in the hard and strong heat-treated condition. The strength and hardness of the latter material may be further increased by heating for 12 to 18 hr. at 300 deg. F. This reheating to a relatively low temperature is known as artificial aging.

When both copper and magnesium-silicide are present, as in Duralumin, aging occurs substantially at room tem-

Condensed from a paper presented at the Cleveland aeronautical meeting of the S.A.E., Aug. 26 to 28.



Micrographs of aluminum alloys containing 4.05 per cent of copper. The view at the left shows the structure of metal cast in a cold graphite mold, reheated to 1,000 deg. F., and then cooled slowly, through a period of 120 hours, to room temperature. A uniform distribution of particles of copper-aluminum precipitate is seen. View at right shows the effect of quenching the same alloy in cold water after the soaking period. The copper is retained in solid solution

perature. This is known as natural aging, in contrast with artificial aging at elevated temperatures. If this alloy is tested immediately after quenching, it shows a tensile strength of about 45,000 lb. per sq.in., and during the next four days, the strength increases gradually from 55,000 to 60,000 lb. per sq.in. After this period of time there is substantially no further change.

Table I gives a summary of the important characteristics of commercial aluminum alloys of the type discussed above.

Magnesium and the magnesium alloys mentioned now are made that are stable under most atmospheric conditions. For use in salt water, electrodeposited rubber is the only coating which has been found to give satisfactory protection.

Owing to the importance of corrosion, especially in aircraft, much time and effort has been given to a study of this problem. This has had a tendency to exaggerate the importance of corrosion in other fields. While it should be recognized that the effect of corrosion of thin sections is severe, a small amount of corrosion on heavier sections, such as castings or forgings, is relatively unimportant.

Accelerated corrosion tests are useful only in comparing the relative corrosion resistance of the various aluminum alloys and in studying the effect of changes in fabrication procedure. Attempts to interpret the results of such tests in terms of service conditions are apt to prove extremely misleading. Visual examination and change in weight of the samples have proved entirely unsatisfactory for evaluating the effect of corrosion on aluminum and its alloys. The method now generally used consists in exposing standard tensile-specimens to a corrosive condition and making a tensile test on these samples after different exposure periods. Tensile strength and elongation thus observed are compared with the same properties obtained from similar samples, which have not been subjected to corrosive influences. The percentage decrease in tensile strength and elongation are used to evaluate the effect of corrosion. Alternate immersion of samples in a corrosive salt-water solution containing a small quantity of hydrogen peroxide produces in 48 hours roughly the same change in tensile strength and elongation as would be obtained after three or four months in the salt spray.

The resistance of commercial aluminum to ordinary atmospheric conditions first gave rise to the belief that this metal was particularly resistant to corrosion; and so it is by comparison with many other metals. But the addition of certain alloying elements decreases this resistance. The high-purity aluminum, containing from 99.7 to 99.95 per cent of aluminum, recently made available by a new electrolytic refining process, has a much higher corrosion resistance than the commercial grade of 99.0 per cent aluminum, which has small amounts of iron, silicon and copper as impurities. Manganese seems to be one element that can be added to aluminum in small quantities without materially reducing its corrosion resistance; therefore, the alloy containing about 1.25 per cent of manganese has found extensive use in producing durable cooking utensils. The corrosion resistance of the heat-treatable aluminum alloys is, in general, considerably less than that of commercially pure aluminum or the aluminum-manganese alloy.

Since corrosion involving uniform solution of the surface of aluminum is readily determined by visual inspection, it is not to be greatly feared. If it becomes localized in certain areas, however, pitting occurs, and is more serious, because the pits produce a notch effect, which causes a decrease in the ductility of the members, as well as in its tensile strength. Thus, failure is likely to occur suddenly, without the usual amount of plastic deformation.

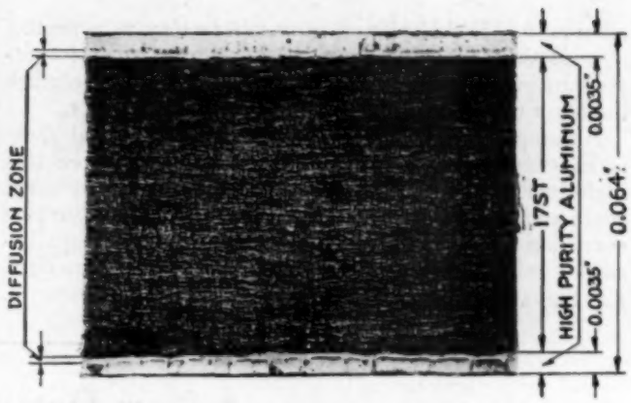
Intergranular corrosion sometimes occurs in certain of the heat-treatable aluminum alloys. Corrosion of this type proceeds along the grain boundaries, and therefore considerable deterioration may occur with only a relatively small amount of visual corrosion. Intergranular corrosion causes a decrease in tensile strength with a marked reduction in elongation. This is probably because of the same sort of notch effect that pitting produces.

Artificial aging of certain of the heat-treatable aluminum alloys at an elevated temperature to produce maximum strength and hardness produces a marked decrease in corrosion resistance. For this reason, thin sheet of alloys in the artificially aged condition are not recommended for aircraft construction. As previously stated, when both copper and magnesium are present, artificial aging is not required to produce maximum strength and hardness. When copper only is present, however, substantially no change in properties occurs dur-

ing standing at room temperature, but aging for 12 hr. at 290 deg. F. produces approximately the same strength and hardness as natural aging gives to the aluminum-copper-magnesium alloy. The 51S alloy, containing magnesium and silicon, shows an appreciable increase in strength and hardness during room-temperature aging, but heating for 18 hr. at 320 deg. F. is required to develop the maximum properties. Likewise, the C17S aluminum-copper-magnesium alloy containing about 1 per cent of added silicon ages naturally at room temperature, but artificial aging raises the tensile strength to 65,000 to 70,000 lb. per square inch.

It is generally believed that the aluminum-copper-magnesium-silicide alloy, naturally aged at room temperature, is susceptible to intergranular corrosion, but H. C. Knerr determined, in his experiments at the Naval Aircraft Factory, that the rate of quenching this material has a marked influence upon its susceptibility to intergranular corrosion, although previously the rate had not been considered important.

These alloys usually were heat-treated in a bath of fused sodium nitrate, because of the necessity of having close temperature control. It often was found convenient to quench the alloys in hot water, so as to dissolve the nitrate which remained from the heat-treating bath. Mr. Knerr showed that this quenching in hot water produces material which is particularly susceptible to intergranular corrosion. The universal practice now is to quench in cold water and, if necessary, to rinse in hot water, to remove the nitrate. Properly fabricated and quenched strong aluminum alloys of the type containing both copper and magnesium with no added silicon (17S) are more likely to corrode by pitting than by intergranular attack.



Another micrograph showing the full cross-section of 14-gage Alclad 17ST sheet. The diffusion zone between the alloy core and the pure aluminum surfaces shows the character of the bond

To meet the demand of the aircraft industry for a strong corrosion-resistant aluminum alloy sheet, a new product termed "Alclad" has been developed. It possesses the excellent corrosion resistance of high-purity aluminum, combined with the good mechanical properties of the strong heat-treated aluminum alloy, 17S. Its aluminum-alloy core is covered with thin layers of pure aluminum. This is accomplished by producing a composite ingot in which the outer 5½ per cent of the thickness consists of aluminum having a purity of 99.7 per cent. These surface layers are alloyed to the core so that, when the ingot is rolled to sheet, the pure aluminum surface layers are still 5½ per cent of the total thickness of the sheet and are bonded to and integral with the core. This product is illustrated in an accompanying micrograph.

The high-purity aluminum surface not only protects the alloy from corrosion by acting as a covering, but also exerts an electrolytic protection over exposed areas of the alloy, as at the sheared edges of sheet or in abraded areas. This is also of importance in aircraft structures in which rivets of the uncoated alloy are used. The rivet heads receive very substantial protection from the pure aluminum surface of the Alclad sheet. Fourteen-gage (0.064-in.) sheet tensile specimens have been found to lose nothing in tensile strength or elongation after an exposure to the spray of 20-per cent solution for a period of two years.

Designers should not overlook the detrimental effect of putting in contact with aluminum other metals, such as copper and brass, which are more electropositive, for these metals, when in contact with aluminum alloys, greatly accelerate the corrosion of the

Table I—Properties of Some Aluminum Alloys

Alloy Designation	Nominal Composition Cu	Fe	Si	Mg	Mn	Al	Mechanical Properties: Tensile Strength, Lb. per Sq. In.	Yield Point, Lb. per Sq. In.	Elongation, Per Cent in 2 In.	Comparative Corrosion Rating[7]
2SO[2]	...	..	....	...	....	99	12,000 to 16,000	.....	30–45	A
2SH[3]							22,000 to 30,000	.....	4–1	A
3SO[2]	...	..	....	...	1.25	97	15,000 to 18,000	.....	15–30	A
3SH[3]							27,000 to 35,000	.....	4–1	A
17ST[4]	4.0	..	....	0.5	0.5	92	55,000 to 63,000	30,000 to 40,000	18–25	C
Alclad 17ST[4]	4.0	..	....	0.5	0.5	92	50,000 to 58,000	27,000 to 36,000	18–25	A
A 17ST[4]	2.5	..	....	0.3	....	95	35,000 to 45,000	15,000 to 20,000	20–28	C
B 17ST[4]	3.5	..	....	0.3	....	94	42,000 to 50,000	20,000 to 25,000	20–28	C
25SW[5]	4.5	..	0.8	..	0.8	92	45,000 to 53,000	15,000 to 30,000	15–22	C
25ST[6]							55,000 to 63,000	30,000 to 40,000	16–25	E
51SW[5]	...	..	1.0	0.6	....	96	30,000 to 40,000	15,000 to 20,000	20–30	B
51ST[6]							45,000 to 50,000	30,000 to 40,000	10–18	E
C17SW[5]	4.0	..	1.25	0.5	0.5	92	55,000 to 63,000	30,000 to 40,000	18–25	D
C17ST[6]							63,000 to 70,000	50,000 to 55,000	8–14	E
195*a*	4.5	..	....	...	....	93	28,000 to 50,000	13,500 to 27,000	12–0	C

[2] Soft annealed wrought material.
[3] Hard-rolled material.
[4] Quenched and naturally aged.
[5] Quenched.
[6] Quenched and artificially aged.
[7] A indicates highest corrosion resistance.
a Refers to castings only; properties vary with heat-treatment.

aluminum. Nickel plating is unsatisfactory as a protective coating for aluminum, because any small imperfections in the coating allows a corrosive solution to reach the alloy underneath and electrolytic action results.

Although the pure aluminum surface of Alclad sheet is an excellent protection for the alloy core, even this high-purity aluminum will exhibit an etched or roughened surface under some conditions of service. This surface corrosion is unimportant in its effect upon strength because, unlike corrosion of most other metallic materials, pits that start in the surface do not continue into the core. As soon as a small area of the alloy core is exposed, the electrolytic action of the surrounding pure aluminum becomes affected and the attack cannot proceed into the alloy. In several instances the appearance of surface attack on Alclad sheet has been taken as an indication of deterioration of the material, but in these cases microscopic examination has shown that the attack was confined to a very slight depth below the surface of the sheet and had not even penetrated through the thin surface layer of pure aluminum. Mechanical tests showed that the strength and elongation had not been impaired.

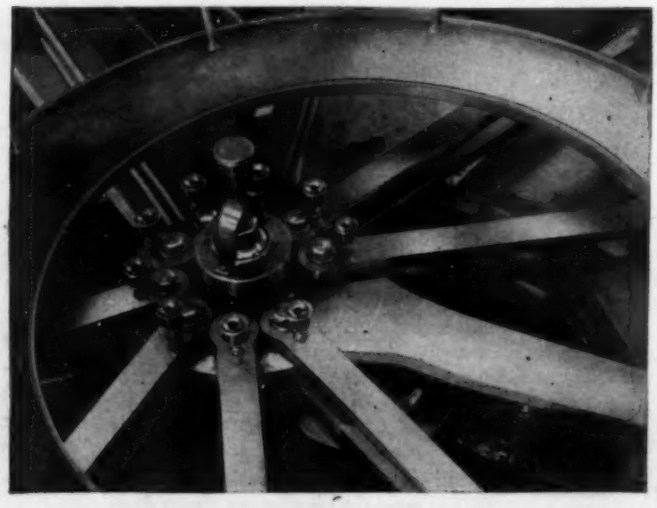
A New Design That Is Old

By Frank C. Hudson

RADIAL airplane engines have won an enviable reputation, and the compact grouping of the auxiliary connecting rods around the enlarged end of the master rod is a good example of ingenious designing. We have naturally hailed it as the result of modern designing, encouraged by the necessity of getting a compact internal combustion engine for the airplane.

Strangely, however, the design antedates both the airplane and the internal-combustion engine. For, way back in the days when the reciprocating steam engine was in its prime, about 1870, in fact, George H. Corliss, builder of the engines that bore his name, designed and built a ten-cylindered radial pumping engine for the Hope Street station of the Providence, R. I., water works. The cylinders were horizontal and the shaft vertical and the connecting rods functioned in the same way as those of the modern airplane engine, as can be seen in the illustration.

Instead of the auxiliary rods fitting between the flanges of the master rod, the latter was a single plate and the auxiliary rods were double, but the idea is identical. This was, of course, a slow-moving engine as can be imagined from the oil cups that were filled by the oiler who stood on the circular platform and filled the cups while the engine was in motion. Probably the modern designer knew nothing of this engine, which was the only one that ever came to my notice before the new radials began to appear. All of which indicates that, given the same problem in design, the average engineer solves it in much the same way.



A radial engine of the steam era

An example of this kind is beneficial in a number of ways. It shows us that all the engineering ingenuity and ability is not confined to the present generation. It is also well to remember that the engine which the late Charles Manly built for the Langley airplane, probably the first strictly aviation engine every built, was a 5-cylinder radial.

The Draftsman Learns a Lesson in the Shop

By Wm. F. Kunz

A RECENT experience illustrates the value of close contact between draftsman and machine operator. A new design, reaching into a new field, had been completed, blueprinted, had had patterns and castings made, and was ready for machining. The man working the job, located close to the shop drafting room, an expert mechanic and long connected with the firm, entered the office with the request, "We'd better change this thread."

The draftsman scanned the blueprint a moment.

"What'll I change that thread for, Joe?" he asked, "the toolroom has a tap that will cut that thread."

"Sure they have, but we'll have to make a special chuck to hold it."

"They have a chuck, too."

"Yes, but it won't fit my lathe, and we can never do this work on the small lathes that can use the chuck."

"That's right," said the draftsman, thoughtfully.

"If it was changed to a standard straight pipe thread I'd be fixed just right to go ahead."

The draftsman studied the blueprint. The change suggested would alter the thread from 14 to the inch to 11½ to the inch and the diameter about $\frac{1}{32}$ in. A little study convinced him that it could easily be changed without affecting the operation of the design, nor weakening it in any way. He made the change.

This is but a trifling instance of the value of close contact between draftsman and workman, but when one takes into consideration the numerous times these changes are made, at times for greater efficiency, more often for more economical cost of production, the advantage of this close contact is emphasized rather forcibly.

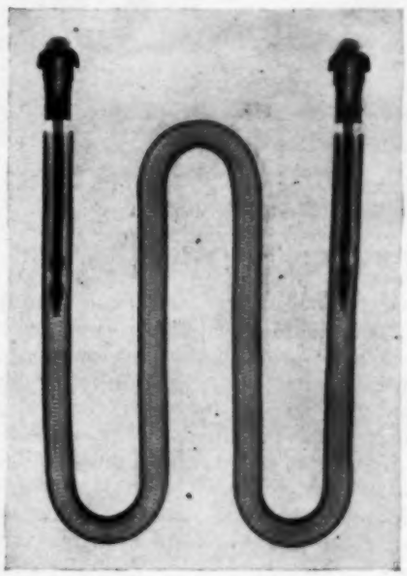
Sheath Wire–

A New Product for Heating Elements

By F. E. FINDLAYSON
Industrial Department, General Electric Company

ALTHOUGH sheath-wire heating elements are limited in service to a maximum temperature of about 1,000 deg. F., their application is by no means limited to localized heating, important as that field has become. Before considering their wide applicability in industry, however, a brief description of the unit and its manufacture is in order, for without such particulars the advantages and limitations of this product may not be apparent.

Sheath-wire units consist, in general, of five different parts: the sheath, the coiled resistor, the "cold" terminals, the connection terminals, and the insulation. The X-ray photograph, Fig. 1, shows all of the parts and their relationship to each other. The units are made by winding a helix of nickel-chromium resistance wire of proper size and length, and attaching the "cold" terminals which are simply heavy nickel wire. This resistor with its terminals then is assembled in a straight tube, which is of material suited to act as a sheath. The tube is filled with finely powdered magnesium oxide, and then is reduced in diameter by swaging. The swaging process compresses the magnesium oxide powder until it becomes nearly as hard as rock. In this state magnesium oxide is a fairly good conductor of heat, but it still is an electrical insulator.



Many problems encountered in the application of heat by electric resistors, especially in restricted spaces, have been met by the metal-sheathed units here described. Compressed magnesium oxide powder is the heat-conducting insulator employed.

After the swaging is complete the unit can be formed into intricate shapes without affecting the relative positions of the coil and the sheath. By referring to Fig. 1 it will be seen that the coil remains perfectly centered even around the sharp bends.

Power connections are made to the unit through suitable terminal connectors. These connectors are attached to the "cold" terminals by stripping back the sheath and exposing an end of the "cold" terminal sufficiently long to enable a connector to be attached to the terminal either by swaging or by brazing, depending upon the temperature of the final application. The connector is insulated carefully from the sheath by a suitable insulator, usually of mica.

Sheath-wire can be varied not alone in physical formation but in length and wattage. The length can be such as to meet the requirements of almost any application. A unit 6 in. long can be constructed, provided the wattage required falls within limits of manufacturing feasibility. On the other hand, a unit 150 in. long can be made almost as readily. Lengths much beyond either of these limits are not usually practicable because of the difficulties in manufacture. Practically all industrial application, however, fall well within these limits.

The wattage of the unit is determined, of course, by the resistance of the core wire and the voltage of the circuit on which it is operating. The core wire resistance can be varied widely by changing its diameter or length, or both. Units as large as 2,500 kilowatts connected load have been applied in a single machine, while units are being made continually with a rating of 50 watts or less.

Sheath-wire is adaptable to almost any low-temperature application from the heating of air and water to the melting of white metals, and the heating of acids. In numerous instances units have been applied where no other means of heating, either electric or fuel, would meet the requirements. The nature of the unit makes intricate formation possible. Heat can be placed exactly where required and in the proper amounts.

Sheath-wire is adaptable to such a variety of uses partly because its construction makes the sheath essentially independent of the current carrying resistor. The sheath serves only as a protective covering for the heating element. It can be cast into metal, immersed in conducting liquids, clamped against metallic surfaces, or placed in contact with combustibles or explosives. When properly applied, there is no danger of shock, short-circuit or ignition of combustible material.

Rating for a given unit is determined for the particular application by the allowable watts per square inch of radiating surface. The higher the watts per square inch, the higher is the temperature at which the unit must operate; and since sheath-wire units are limited as to safe operating temperatures, it is necessary to rate the units in such a manner as to keep within the temperature limits of a given kind of sheath. Then too, it often is essential to limit the surface temperature to

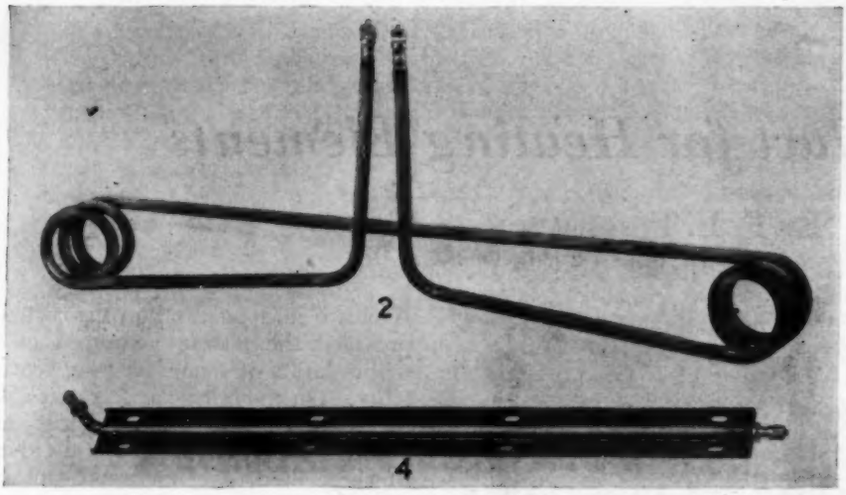


Fig. 2—A sheath-wire unit formed to give a particular heat distribution in a small oven. Fig. 4—Clamp-on unit equipped with metal vanes to facilitate rapid heat distribution

prevent burning of the material with which the sheath is in contact. In order to keep the watts per square inch within safe limits, it frequently is necessary to resort to large diameters or long lengths even though other considerations do not require this expedient.

Possible formations, disregarding practicability from the heating standpoint, are limited only by the radius on which the unit can be bent. In general, the larger the diameter of the unit, the greater the minimum radius of curvature. For most ordinary purposes, it can be taken as a rule that the minimum radius of curvature should not be less than the diameter of the sheath.

Since the sheath is independent of the electrical system, sheath materials best suited to external conditions can be employed. The most used material is ordinary mild steel, for it is not only the cheapest material, but also the best within its limitations.

Steel sheath units are used quite extensively for air heating purposes in ovens, dryers and miscellaneous applications. The unit shown in Fig. 2 was formed to give a particular distribution of heat in a small oven, and illustrates the flexibility of formation where accurate heat distribution is essential.

Plain steel sheath units are somewhat limited in application for air heating purposes, because of the tendency of the steel to scale at higher temperatures. For this reason it is considered best practice to keep the temperature of steel sheath-wire units under 750 deg. F. A substantial heat gradient always must be allowed for between the surface of the sheath and materials heated.

When steel-clad units are to be employed at temperatures above 750 deg. F. they often are treated by a process known as "Calorizing" which consists in heating the steel in an air-tight retort with finely divided aluminum and aluminum oxide in a reducing atmosphere. This process causes the aluminum to permeate the steel and to form a coating the under part of which is aluminum while the outer part is aluminum oxide. The result is a metal which resists heat and does not oxidize excessively until the temperature exceeds 1,200 deg. F. With calorized steel sheath it is permissible to run the sheath temperature up to 1,000 deg. F. It is not advisable to exceed this temperature because of the gradient which exists between the core wire and the sheath. The core wire naturally runs at a considerably higher temperature than the sheath itself.

Steel sheath units both calorized and uncalorized, are used extensively for heating metal surfaces by direct contact between the sheath and the surface. The unit shown in Fig. 3 was designed for such an application. In a unit designed for relatively high heat density, it is advisable to provide better thermal contact than is possible by simply attaching the unit to a flat metal surface. By clamping the unit into tight-fitting grooves, or by equipping it with metal vanes having a flat under-surface which can be attached to the metal to be heated, Fig. 4, much better thermal contact is obtained and, therefore, more wattage can be concentrated in a smaller area than would be feasible otherwise.

Steel sheath units are suitable for heating mineral oils by direct immersion in the liquid, but the relatively low thermal conductivity of oil makes it necessary to rate an oil immersion heater lower per unit of area than one for immersion in most other liquids. Just what the actual rating should be depends upon the viscosity of the oil itself and whether circulation is forced or natural. Special precautions must be taken in heating oil to prevent the accumulation of carbon or sludge on the surface of the unit, for such an accumulation acts as a heat insulator and causes the unit to overheat and burn out.

Lead covered steel units, such as that shown in Fig. 5, have been applied widely to the heating of corrosive solutions, such as plating and pickling baths, where it is not practicable to install units with sheaths made of metals such as steel, copper or nickel which are more active chemically. Units of this class can be used for heating practically any acid or other solution which does not attack lead, and where the temperature required does not exceed about 400 deg. F.

Practically the only application of copper sheath units is in the heating of water, which is, however, a very important one. Copper is particularly well adapted for this purpose because of its properties of resisting corrosion when in contact with water.

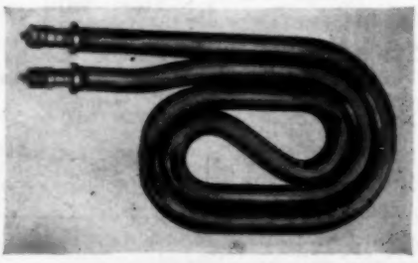


Fig. 3—A unit of sheath wire made for heating by direct contact with a metal

Heating units which are to be immersed directly in water can be given a relatively high rating, for the ability of water to absorb heat from a unit seems almost unlimited as long as good contact is maintained between the unit and the water. In practice, however, the rating of a water heater is decidedly limited, and an over-rated unit operating in water actually will overheat and burn out despite the fact that the temperature of the water itself does not exceed 212 deg. F. at atmospheric pressure. Overheating results when steam is formed in immediate contact with the surface of the sheath, and ruins the unit.

About the only way to protect an over-rated water immersion unit is to maintain circulation of the water sufficiently rapid to prevent the formation of steam pockets on the unit surface. Even a conservatively rated unit will overheat, if free natural circulation around the unit is not provided.

An excellent means of realizing the benefits of the precious metals in a relatively cheap unit is by plating the unit with the metal desired. In this way, units having the properties of chromium, silver, pure nickel, etc., are obtained.

The principal application of plated sheaths at the present time is the nickel-plated copper sheath used for heating vegetable or animal oils used in frying. In Fig. 6 a heating unit for use in doughnut machines is shown.

Sheath made from so-called "nickel-silver," really an alloy composed of copper, nickel and zinc, is used principally for high temperature work. The maximum temperature of both the sheath and the unit in this case is 1,000 deg. F. This alloy is rather inactive chemically and readily stands temperature up to 1,000 deg. F. without excessive oxidation.

Such materials as aluminum, brass, Everdur and Monel metal, have been supplied for special applications of other kinds, but are relatively little used as compared to the metals already discussed.

Probably the most interesting application of sheath-wire is the cast-in unit. Immersion units of this class already are seeing extensive use in melting white metals such as lead, tin, babbitt, type metal, etc., while cast-in hot-plates make convenient heating elements for electric ranges, composition presses and, in general, for heating surfaces over which even heat distribution is desirable.

Steel sheath-wire alone is suitable for cast-in units. The steel sheath, being absolutely tight and having a melting point higher than that of iron, makes contact with molten iron possible.

In the production of cast-in units the steel sheath-wire is suitably formed to give the required distribution of heat and to take care of the wattage to be used. The unit then is supported centrally in a mold and cast-iron is poured around it. The resulting product has a large, evenly heated radiating surface, and the sheath-wire is thoroughly protected by a thick wall of cast-iron.

Two typical cast-in units are illustrated by Figs. 7 and 8. That shown in Fig. 7 is a 10-kw. immersion unit of the type employed for melting stereotype metal in the printing industry. Thousands of these units are installed in printing plants in all parts of the country.

The hotplate type of unit, one of which is illustrated by Fig. 8, is flexible in size and rating and has been applied to a great variety of uses. Almost any kind of low temperature heating requirement can be met by the hot-plate type of unit, but, because its cost is considerably higher than open sheath wire, its use ordinarily is limited to applications requiring a flat, evenly heated surface.

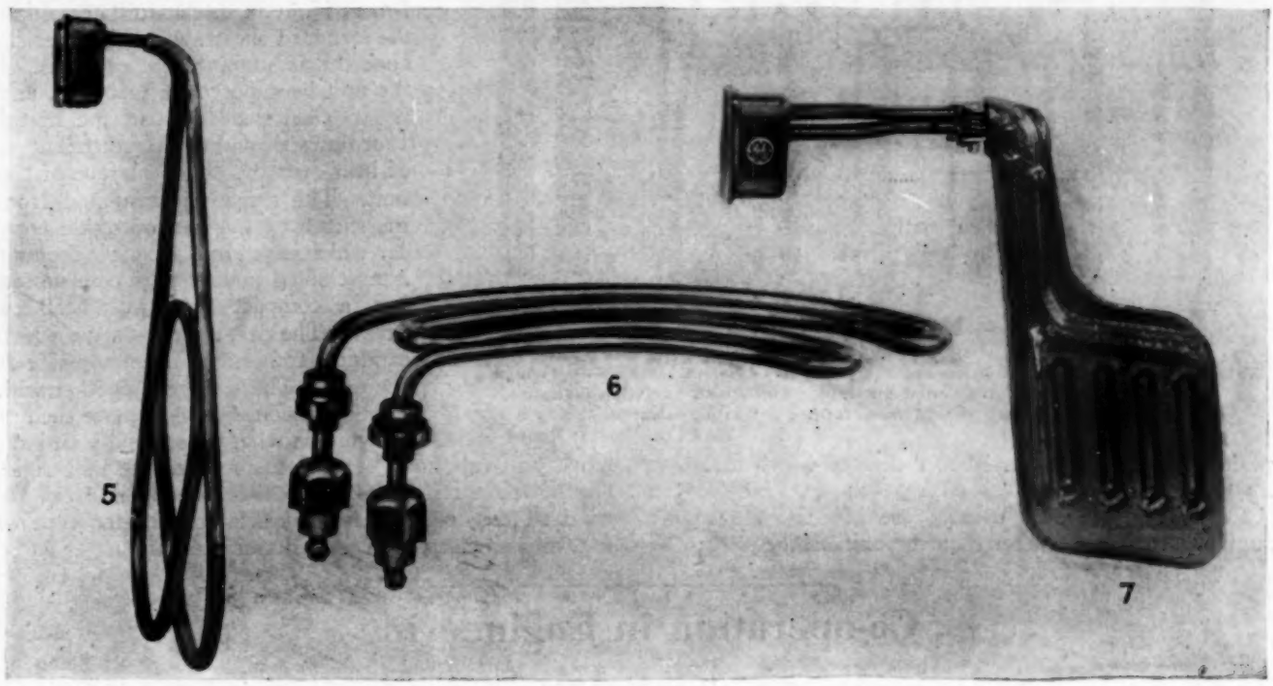


Fig. 5—Lead-covered sheath unit for immersion in corrosive solutions. Fig. 6—A copper-sheathed, nickel-plated unit for use in a doughnut frying kettle. Fig. 7—Cast-in immersion unit used for melting stereotype metal

Other metals such as aluminum and brass sometimes are used for making cast-in units. Sheath-wire can be cast into any metal having a melting point lower than that of steel.

Construction based on the same principle used in the helical coil sheath-wire units already described is embodied in a number of variations from the standard double-ended round tube. Chief among the varients is the cartridge type of unit shown in Fig. 9. This is a single-ended heater generally of small dimensions and low wattage,—usually less than 1 kilowatt. Units of this type are used principally as localized heaters in process machines and devices requiring a small amount of concentrated heat, such as glue pots, soldering irons, and tinning pots.

Such units are built around a lava core on which is wound the heating element. The core and coil are assembled in a tubular case, usually of brass. The space between the case and the core then is filled with magnesium oxide and the case is reduced in diameter until the mag-

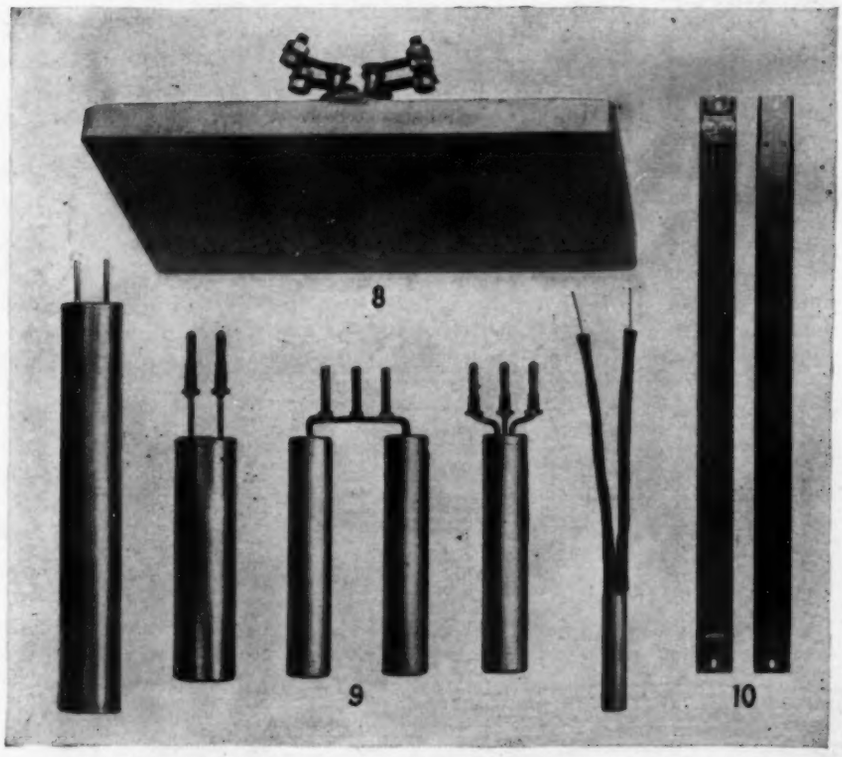


Fig. 8—A hotplate unit cast around a sheath-wire element. Fig. 9—Cartridge-type heating units of different patterns. Fig. 10—A variation from the standard sheath wire, termed a "strip heater"

nesium oxide is compressed to a density which makes it a good heat conductor.

Cartridge-type units usually are inserted in a hole, slightly larger in diameter than the unit, in the part to be heated. The unit swells in service until it fits the hole very tightly. This gives excellent thermal contact and insures efficient transfer of heat as well as long life for the unit.

One of the most used variations from the standard sheath-wire unit is the strip heater shown in Fig. 10. This heater is designed to fill the double purpose of an air heater and a clamp-on unit for operation up to 750 deg. Fahrenheit.

In the manufacture of this unit a nickel-chromium wire is wound in the form of a helix similar to that used in the standard sheath-wire. The resistance coil is supported at each end of the unit by a porcelain insulator, and is stretched the length of the heater four times, providing even distribution of heat over the entire surface of the unit. The resistor is insulated from the sheath by magnesium oxide powder which is put in place after the unit is assembled and then is compressed into a compact mass in a 250-ton press. The press carries a die which produces four ridges in the top side of the unit. These ridges, together with the depressions between, place each of the coils in what is essentially an individual half-tube, and serve also to make the unit rigid. The bottom surface is flat. Other variations from the standard construction are a special car heater type of unit, and an electric steam radiator unit.

Co-operation in Engineering

By H. D. James

Consulting Control Engineer, Westinghouse Electric & Manufacturing Company

ENGINEERS in active contact with projects under development are often confronted with many new problems. The usual method of procedure is to investigate these problems with their own staffs and often by their own personal efforts. In doing so, it is often found that fundamental data is required that is difficult and expensive to obtain. Larger organizations have therefore established research laboratories for more extensive and careful investigations.

Research workers have devised many ingenious methods and types of apparatus for obtaining the required data. The various testing laboratories and technical schools have been appealed to for assistance in solving some of these problems. A more recent development is the co-operation of groups of manufacturers and users through the medium of national societies for the purpose of obtaining data of benefit to their industries as a whole. This co-operation is entirely voluntary and is an indication of the broadening views of our industrial leaders.

We have seen industry co-operate through technical societies and trade organizations for the establishment of technical and manufacturing standards. Some of these commercial standards have been approved by the government and have become legal standards for industry. The co-operation between manufacturers and users to obtain a wider engineering knowledge and to develop better processes in certain fields of activities is another very hopeful sign. This plan enables such a group to draw upon the experience and obtain the advice of all engineers and organizations in a position to render service in an investigation, and to distribute the expense.

IF DRAFTSMEN will observe the following simple precautions, cleaner and better appearing drawings will result. To do so requires but little time, yet too often the rules are overlooked.

1. Brush off the drawing board each morning. This will help to keep clothing, hands and drawing clean.

2. Use a clean cloth frequently to remove the pulverized graphite from straightedge and triangles. This will prevent the graphite from working into the drawing.

3. Do not allow triangles to ride up and down the board against the straightedge unnecessarily, as this smears a pencil drawing.

4. Wash hands several times a day, principally to remove the pencil graphite.

NEW ALLOYS

in Railway Rolling Stock

By FRED H. COLVIN
Editor, American Machinist

Aluminum forgings, and steel alloyed with chromium, nickel, vanadium or other metals, today are finding wider use in railway work than ever before. Demands for lighter and stronger parts are helping to accelerate the adoption of these materials

DEMANDS for increased power and greater efficiency in motive power have led, or forced, designers of locomotives to consider the use of materials with physical properties far superior to those obtainable a quarter of a century ago. Limited by track gage, by clearance widths and heights, and by the loads that are permissible on both bearings and rails, the designer has studied the development of materials for the automotive industry, and has adopted some of the same materials for locomotive parts. In other cases he has urged and aided the development of new materials to meet the special needs of locomotive construction.

As an example of the increased requirements, the present duties of the freight car wheel may be cited. Chilled-tread wheels were put in service in 1850. Since that time wheel loads have increased 800 per cent. In other words, one wheel now carries the load formerly distributed over eight wheels. Although chilled wheels still are used, the material of which they are made, and the way in which they are treated, gives them a greater safety factor than before, despite the added load. Today, a single wheel for a 70-ton car often weighs 850 pounds.

To increase safety still further, the wrought-steel wheel has been developed. This wheel is forged and rolled from a single block of high-carbon steel. It is stronger than the cast-iron wheel and has taken the place of the latter on all passenger cars and under all tenders of any size. The wrought-steel wheel is being used extensively also under heavy freight cars.

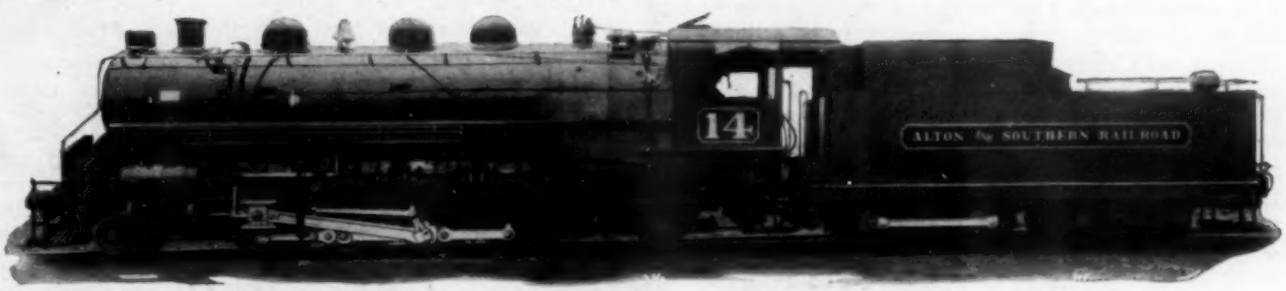
Many changes also have taken place in the frames of locomotives. These formerly were of forged wrought iron and later of low-carbon steel, but today many frames are single steel castings. One concern has gone several steps further, and now is casting both side frames, cross-ties, bumpers, and, in some cases, the whole cylinder saddle in one solid piece, termed a bedplate. Frames also have been made of a solid slab of cast steel from which the pedestal jaws were cut, first by drilling, and then by finish-slotting. In at least one case the cross-ties between the frames have been welded in place.

Vanadium-steel castings now are used in locomotive frames, and in some small mining locomotives the frames are made of armor plate slabs, with the pedestal jaws cut out by means of a cutting torch.

In connecting rods, axles, crankpins, and boiler sheets, alloy steels today play a most important part. The ordinary carbon steels are being developed by careful attention to ingot design, methods of forging and heat treatment, so as to have physical properties from 15 to 25 per cent better than were obtainable twenty years ago. Specifications recently adopted by the American Railway Association and the American Society for Testing Materials show the advances that are being made.

Steels of various compositions, using such alloying elements as chromium, vanadium, nickel, and manganese, are giving a good account of themselves in high duty forgings. Such alloy steels are used advantageously to reduce the weight of valve linkages and other reciprocating parts. Higher boiler pressures have led to the use of high tensile boiler plates. The use of 3 per cent nickel steel by the Canadian Pacific has permitted the boiler pressure to be increased from 200 to 250 lb. per sq.in. without any change in thickness of boiler plate.

Experiments have been made also with strong alu-



A locomotive and tender equipped with aluminum alloy side rods and reciprocating parts

minum alloys in side rods, main connecting rods, crossheads, crosshead shoes and valve linkages. These parts are forgings except for the crosshead shoes which are heat-treated aluminum castings. Up to a year ago, locomotives using these parts had seen service ranging from 42,000 to 53,000 miles with results reported as satisfactory. In these cases reduction in weight of parts is reported to have ranged from 16.5 to 45 per cent. as shown in Table I.

Aside from the saving in weight, considerable advantage is claimed in securing a better balance of reciprocating and rotating parts. This is said to reduce materially the rail-hammer which has been a subject for discussion for many years. A reduction in bearing wear also is cited in favor of locomotives equipped with the aluminum alloy parts listed above. Because of the high thermal conductivity of aluminum, it is claimed that bearings run much cooler than before, and that, on four locomotives now running, the wear of pin bearings is about one-third as great as on locomotives equipped with steel rods.

An important factor to be considered in connection with the use of alloy steel or other modern alloys is their effect upon shop practice, especially in the smaller shops of railroad systems. With the old materials any blacksmith could rework piston rods or crankpins so as to use the material for smaller sizes or for other purposes. But, where heating and handling at proper temperatures is as important as with the alloy steels and other alloys now in use, it becomes necessary to restrict all heating and heat-treatment to such shops as are equipped properly, both mechanically and by experience, to perform such operations satisfactorily.

Knowledge as to handling the new alloys will spread as their use increases, and proper equipment will be provided in shops where the work can be undertaken economically. During the transition period, however, great care is being exercised to prevent alloys from being mistreated, as the consequences of the failure of parts brought about by lack of care in this regard may bring serious results.

High-Frequency Motors for Portable Tools

By C. B. Coates

Electrical Engineer, Chicago Pneumatic Tool Company

ELECTRIC drills of the portable type were introduced more than twenty-five years ago and were wound for operation on direct current, to conform to the prevailing conditions in the industrial plants at that time. These tools were generally series-wound, but several years later the larger sizes were compound-wound to give better speed regulation and consequently higher armature speed at full load with limited free speed and greater brake horsepower.

A few years after the introduction of the d.c. drill, a.c. drills were developed. These were built to operate on 60 cycles and other prevailing frequencies, such as 40 and 25 cycles. They had good speed regulation, but their weight, limited by lower rotor speeds to 3,600 r.p.m. at 60 cycles and correspondingly less for the lower frequencies, was somewhat of a drawback.

About 1908 the now well-known universal drill was introduced and has met with great favor on account of its ability to operate interchangeably at practically the same speeds on either direct or single-phase alternating current of a given voltage. The universal tool is, however, series wound.

While the falling off in speed under load was considered to be of advantage in some classes of work, it has now been demonstrated that the sustained speed, as of the induction motor, is generally preferable because it accomplishes a greater amount of work.

In order to reduce the weight of the induction motor tool it is evident that the rotor speed must be brought up. This can only be done by increasing the frequency, since the 60-cycle drills were practically all provided with the minimum number of poles. The synchronous speed of a two-pole 60-cycle motor is 3,600 r.p.m., whereas the d.c. and universal tool motors have free armature speeds of from 8,000 to 16,000 r.p.m. and even higher in some of the smaller sizes. Under load these armatures slow down nearly 50 per cent but still have a speed higher than that of the 60-cycle motor.

A frequency of 180 cycles per second was adopted for the high-frequency portable tools, giving a synchronous speed of 10,800 r.p.m. in the two-pole motor used. This is considerably less than the average free speed of the d.c. or universal tool. The result is longer life for the bearings which are generally of the ball type. The slip under normal full load is 8 per cent to 10 per cent, giving an average loaded speed of about 9,800 r.p.m., a higher load speed than that of the d.c. or universal tool with its large speed drop. This, of course, means more power with a given size rotor.

Several factors governed the selection of a standard frequency for these tools. Since it was necessary to obtain spindle speeds for the drills, reamers, and abrasive wheels which would conform to the modern cutting tools, there had to be a point where the reduction in weight of the motor because of higher frequencies would be more than offset by the greater weight of the gearing required to obtain the necessary spindle speeds. A desirable frequency was found to be in the neighborhood of 180 cycles per second. Troubles in ball bearings and difficulties with lubrication at high speed are other limiting factors, although improvement in both directions indicates the possibility of still higher frequencies.

Thus the high-frequency tools meet the requirements of intensified production in modern industry where portable tools are crowded to the utmost and in many cases get very little care. The outstanding advantages are:

1. Greatly increased power for the same weight, the result of higher loaded speeds of the rotor.
2. Reduced weight for a given power output.
3. Practically constant speed at all loads (8 per cent to 10 per cent slip).

So much more work can be accomplished with the high-frequency tool that large numbers of the older types are being discarded. Manufacturers, keeping pace with the rapidly changing conditions, are scrapping the earlier tools to invest in the new frequency converters or motor-generator sets and new wiring in order to gain the advantages of the increased production.

Abstract of a paper presented at the A.I.E.E. Summer Convention, June 24-28, 1929.

IDEAS FROM PRACTICAL MEN

The department, "IDEAS FROM PRACTICAL MEN," is devoted to the exchange of information on methods useful to the machinery industries. It includes all divisions of engineering practice, from design problems to engineering equipment. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

A Piston Leak Gage for Pneumatic Hammers

By P. J. McCULLOUGH
Special Engineer, Scullin Steel Company

FAILURE of a pneumatic chipping hammer to deliver its rated capacity in removing metal might occur even when it is in normal condition, the trouble being due, perhaps, to a few pounds drop in air pressure, lack of lubrication, or fatigue of the operator, who may suggest that the hammer is at fault. The result is that in many cases the cylinder is reground and fitted with a new piston before the amount of wear justifies such a procedure.

On the other hand, some of the hammers that have been reconditioned and assumed to have a very slight leakage, have been found to vary, some having quite an appreciable leakage, as indicated by a leakage test made with the gage shown in the illustrations.

In using the gage, the cylinder and piston to be tested are placed between the two air cylinders as shown in Figs. 1 and 2. Attached to the lower end of the piston rod of the upper cylinder is a metal cap which is used as a head for the hammer cylinder while the test is being made. When air is admitted to the upper end of the upper cylinder there is a pressure of about 800 lb. on the cap so that by the use of rubber gaskets at each end of the hammer cylinder under test there is a positive seal against leakage. A gland prevents its escape into the lower cylinder.

The air supply for making the test is delivered through the test head at the top of the hammer cylinder. This air is taken through a constant pressure regulator valve, as shown in Fig. 2, so that all tests will be made under uniform pressure conditions. If the piston leaks, the flow of air or leakage will be from the top of the hammer cylinder, past the piston and out at the bottom of the hammer cylinder through a tube that leads to the test gage and a variable opening escape valve *A*. On the shaft or stem *B* of this escape valve there is a 32-pitch, 28-tooth gear, which meshes with a 112-tooth gear that is secured to the bezel of the gage.

In addition to the gage hand proper, there is painted on the underside of the glass gage face, a pointer which registers with the gage hand when the escape valve is closed and there is no pressure in the test line. When the valve is wide open, the pointer will be rotated to the extreme right. While in this position, if air is admitted above the hammer piston and leakage should occur, the escape of the air would be so free that little or no back pressure would show on the gage hand, even with a badly worn cylinder and piston, since the air would follow the path of least resistance.

If the valve stem is turned to the right there will be a point reached where back pressure will move the gage hand clockwise until it meets the pointer, which is moving counterclockwise as the escape valve is being closed. If the valve were entirely closed with pressure on the piston and the gage hand indicated no pressure, the pointer and the gage hand would both be at zero position, indicating no leakage at all, a condition which is practically impossible with a piston which is necessarily dry while making the test. The less leakage there is past the

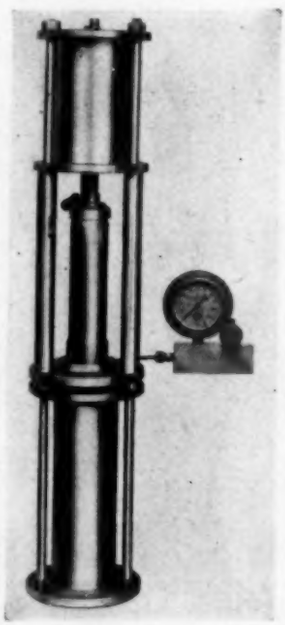
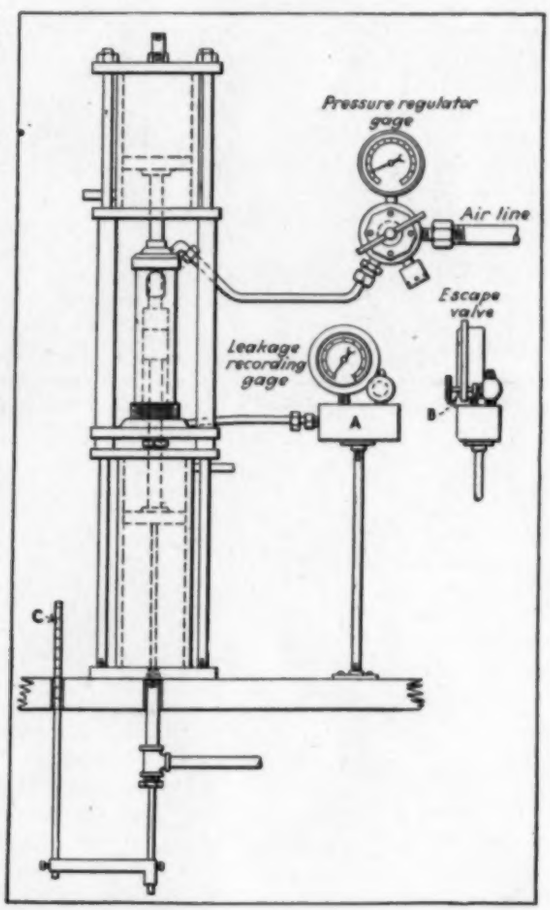


Fig. 1—Leak limit device with a variable opening valve geared to the gage bezel. Fig. 2—Diagram showing the details and the method of gaging the location of the piston in the hammer cylinder



piston, the nearer the pointer and gage hand will be to zero on the dial when they meet.

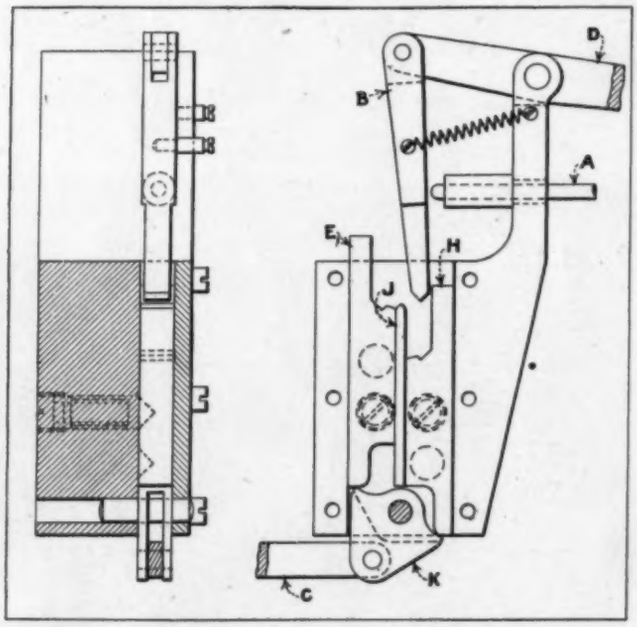
The piston rod of the bottom cylinder forces the piston being tested up the full length of the hammer cylinder, so that leakage readings can be taken at all points. The location of the piston in the hammer cylinder is indicated by a pointer, shown at *C* in Fig. 2.

The maximum permissible leakage due to combined piston and cylinder wear was arrived at by selecting a hammer that was known to be worn almost to the limit and using its leakage number, which was 7 lb. on the gage, as a limit. New cylinders and pistons average two pounds leakage, as indicated by the gage.

An Intermittent Reciprocating Movement

By P. Zulinski

In automatic machines for assembling two or more parts to produce finished or semi-finished articles, there are two or more magazines in which the parts are stacked. In some machines the parts are stacked by the operator, while in others they are fed from a hopper to a chute. In cases where the individual parts are strong enough to withstand the pressure of a uniform-supply controlling mechanism, no extra means are necessary to regulate their supply to the assembling station.



Device for feeding parts from two or more magazines in an assembling machine

When, however, the parts are comparatively delicate and likely to be distorted by ordinary means of selection, other means must be provided. Where distortion is likely to occur, quite a few parts may be damaged, and often the machine must be shut down for adjustment. To prevent such inconveniences, the machine must be fitted with special devices, of which the illustration gives an idea. Essentially, such a device contains a mechanism that is intermediate between a sensitive "detector" attached to one magazine and a shutting-off mechanism attached to the second magazine. The result of the action of the "detector" is transmitted through the device to the second magazine, which it may either leave open for the part to go to the assembling station, or shut off, thus preventing a delicate part from being damaged.

The action of such a device cannot be continuous. It must act only when conditions, as shown by the detector, call for it. When this happens, the resulting motions of the rod *A*, the swinging finger *B*, and the connecting rod *C* open the auxiliary magazine. When the emergency has passed, the detector recedes and the routine operation of the machine is resumed.

In operation, lever *D* moves once with each cycle of the cam, moving finger *B* up and down in unison with it. The rod *A* receives motion only when the "detector," finding no part in the magazine, strikes it, thus moving the swinging finger to the left. The sliding blocks *E* and *H* receive motion from the swinging finger, respectively, according to the position of its point. Part *J* is a partition between the sliding blocks and is attached to the frame of the device. Spring plungers in the frame engaging dimples in the sliding blocks, hold them in the positions to which they are moved by the swinging finger. Through the movement of the sliding blocks, motion is imparted to the bell crank *K*, and through it to the connecting rod *C*, the other end of which is attached to the shutting-off mechanism in the second magazine.

Rod *A* receives motion from the "detector" only when there is no part present in the chute leading from the magazine, so that the sliding blocks are for the most time in the position shown in the illustration. In case rod *A* receives motion from the "detector," the swinging finger is immediately moved to the left, and through the cam motion, moves the block *E* down, thus turning the bell crank and moving the connecting rod *C* to the right. After its downward motion, finger *B* is brought back to its previous position by the action of the cam and by a pull spring attached to it and to the housing. By this action, the rod *A* is brought back to the neutral position. If the "detector" is prevented from striking the rod *A* by the interference of a part in the magazine chute, the lever *D* takes care of opening the passage for parts in the chute of the second magazine, by causing the swinging finger to move the sliding block *H* downward, thus moving the rod *C* to the left.

Where an automatic assembling machine has two magazines and chutes, it is necessary to have two separate, uniform-supply mechanisms, each of which must be provided with one of the devices described. In the illustration, no attention has been paid to the proportions of the individual parts, as they should be regulated by the nature of the work and the design of the machine.

New Equipment at the Show

Executives, designers, and production men who visit the National Machine Tool Builders' Exposition at Cleveland should consult the September 19 number of the *American Machinist* to familiarize themselves in advance with the details of the new machines of major interest to them.

Those who cannot attend will find that this number brings the show to their desks in the descriptions and pictures of the new machinery exhibited.

Characteristics of Mayari Iron

IT HAS been demonstrated conclusively within the last few years that cast iron need no longer be considered as a weak material, nor as a material that cannot be graded closely, provided that the manufacturer will see to it that proper measurers are taken in melting and pouring, and that elements are added to the melt to break up the flake graphite structure of the iron. Nickel and chromium, added in small quantities to the iron, have been found to harden and toughen the resulting metal, and to produce a more uniform product. Silicon, which at one time was considered detrimental, has now been found to make a uniformly hard iron when used in correct proportions with the nickel and chromium. The metals vanadium and titanium, which are deoxidizing agents, also serve to make a uniform and tough cast iron when they are present in small quantities. Although many of these results have been known for many years, they have not been applied practically because of the difficulties encountered in adding the elements to the iron. The purpose of Mayari pig iron is to provide a ready means of obtaining the proper proportion of the desirable elements in the iron by a single addition to the melt.

Mayari iron takes its name from the region of Cuba where the ore was found originally. It is a natural alloy-iron ore containing nickel and chromium, with a small per cent of other metals, and is available on the market as pig iron in various grades as Mayari and Silvery Mayari, which are distinguished by differences in total carbon, silicon, nickel, and chromium content of the iron. This pig iron was used originally in the making of alloy steels, but it is now added in definite proportions in the foundry for making smooth, close-grained cast irons of high strength and toughness. The resulting irons are also remarkably free from sponginess, and because of the greater fluidity of the iron, very thin sections can be cast successfully.

Mayari iron is low in phosphorus and sulphur, which are ordinarily considered undesirable elements in irons. The small quantities of vanadium and titanium occuring naturally in the ore serve to act as deoxidizers, as previously stated. As pig iron, Mayari iron is produced with varying amounts of silicon and manganese, other elements being maintained within a close range. The pig iron is used always in a mixture with other iron, and by varying the percentage of Mayari used, a wide range of cast irons can be produced, differing in physical characteristics, from soft machineable castings to hard, chilled rolls. The composition of Mayari and Silvery Mayari irons are given in the accompanying table.

Ordinary cast iron contains mechanically mixed graphite, and its tensile strength ordinarily ranges from 18,000 to 25,000 lb. per sq.in. The breaking up of the graphite flakes and the deoxidizing of the iron resulting from the addition of Mayari iron is caused by the nickel-chromium combination and the presence of deoxidizing materials. The proportion of Mayari used may vary from 15 per cent to 50 per cent, depending upon the effect desired. Engine cylinder castings, made with an addition of 25 per cent of Mayari iron, have a tensile strength of 40,000 to 44,000 lb. per sq.in. The effect is gained without special heats, and the presence of titanium serves to lessen trouble from "burnt" iron, voids, and gas bubbles. White chilled-iron castings, made with a 50 per cent addition of Mayari, gave a Brinell hardness of 550 throughout the cross-section of the piece, together with remarkable strength. Wear-resistant castings are also made thus for rolls, jaws, and liner plates.

Silvery Mayari is a special grade of Mayari iron with practically double the silicon content formerly recommended, particularly developed to be used as a general-purpose iron without metallurgical control. Alloy characteristics of Mayari iron are increased in Silvery Mayari, the per cents of silicon and manganese being higher, and those of nickel, chromium, and carbon about three-quarters as great as in regular Mayari. Silvery Mayari is used to produce super-strength irons in the ordinary cupola without the trouble usually encountered in heating moulds and similar difficulties. It is added to the charge in quantities up to 25 per cent of the mixture.

Analysis of Mayari and Silvery Mayari Irons

Element	Per cent	
	Mayari	Silvery Mayari
Silicon	0.50 - 0.75 to 2.50 - 2.75	7.00 - 10.00
Manganese	0.45 - 1.00 0.80 - 1.25 1.25 - up	2.00 - 3.00
Phosphorus	0.10 Max.	0.10 Max.
Sulphur	0.05 Max.	0.05 Max.
Nickel	0.80 - 1.25	0.60 - 0.95
Chromium	1.60 - 2.25	1.20 - 1.70
Titanium	0.10 - 0.20	0.10 - 0.20
Vanadium	0.05 - 0.08	0.05 - 0.08
Total Carbon	3.80 - 4.25	2.50 Max.

Castings with light sections may be made by using 10 per cent of Silvery Mayari, in what is called ordinarily a hard-iron mixture. This addition refines the grain of the iron and softens the iron enough for use. The use of less than 13 per cent Silvery Mayari does not have a great influence in raising the tensile strength of castings, but it exerts a great effect in reducing flake graphite and refining the grain of the iron.

Silvery Mayari is especially valuable where strength of castings is essential. Irons with Brinell hardness numbers ranging near 250 may be made, with the castings as hard in the center of a 4-in. section as they are on the outside. These can be machined readily. This iron will also reduce the tendency toward softness in irons with unequal sections, an important feature where resistance to wear is a necessity, such as in automobile cylinder blocks and die castings. Silvery Mayari iron will also take a brilliant polish, and will give a very smooth finish when machined.

For the data given we are largely indebted to the Bethlehem Steel Company

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

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"Machines in the Age to Come"

IN A recent magazine article, Henry Ford is quoted thus: "Compared with what we may expect of machines in the age to come, we have as yet realized very little. In the way of machinery that is automatic, for instance, we have almost nothing. It is not even semi-automatic. And it is the automatic machine that will lift the burden from the shoulders of mankind."

As the largest single purchaser of machines in the world, Mr. Ford's opinion carries the authority of experience, at least. But his statement raises the question of the economics of automatic machine design and its relation to product design.

Any experienced designing engineer can design a fully automatic machine to produce a given product. But how many engineers can design a product that will remain standard long enough to warrant the heavy expense of designing and building fully automatic equipment for its manufacture?

Mr. Ford's own past experience is evidence of the extreme significance of the correct evaluation of the various factors involved. His old car was a triumph of production engineering, of the application of automatic and semi-automatic production equipment. His new one shows clearly the importance that attaches to product engineering.

In the age to come we shall undoubtedly design, build, and use automatic machines undreamed of today, but those machines will be the achievement of engineers who can temper constructive enthusiasm with economic judgment.

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Facts First—Design Afterward

ANY product designed without considering the problems purchasers are likely to encounter in its application starts with a heavy handicap. It may seem to be entirely sound from an abstruse engineering standpoint, and still give rise to so many troubles as to make it fail commercially.

A designer may say, "Well, if they would put a little oil in those bearings now and then, these troubles wouldn't happen," or "If they would adjust the brakes as the instruction book says, such accidents couldn't occur." But has the designer thought of making lubrication automatic? Or has he considered the possibility of brakes that require no adjustment over extended periods?

Why lay down a design until all feasible efforts are made to learn what conditions it must meet in service? Sound engineering demands such a survey and the management should give the engineering department all possible assistance in accumulating the necessary facts. Designing engineers should get into the field on every opportunity, and have as many assistants remain there as are required to keep advised of the situations the product must meet. Otherwise the chances of making and keeping the product successful may be reduced almost to the vanishing point.

It is likely to be far cheaper to accumulate in advance the data needed for a good design, than to overcome shortcomings that arise later.

*

The Inspiration of Machinery

SHERWOOD ANDERSON, who gave people something to talk about by abandoning the big cities for the delights of publishing a country newspaper and living with country people, in a recent address at the University of Virginia, wailed in the approved fashion about the dullness of modern life and the curse of mass production of standardized products and ideas. But before he got to that part of his remarks he told of visiting a modern newspaper printing plant with the editor of the paper, and spoke in poetic terms of the thrill to be had from watching the marvel of intricacy and precision which is the modern newspaper printing press. He expressed surprise that the contents of the newspaper did not measure up to the inspiration of the machine. What Mr. Anderson did not see, or at least not mention, was the fact that that machine was but the embodied imagination of some designer.

It is but too true that the majority of us find thinking entirely too arduous a task, and leave that unpleasant duty to somebody else. That has always been the case, and perhaps always will be. But there is hope for us so long as there are some who have the vision of new means to lift the burdens from mankind, and the skill and patience to engineer their dreams into practical realities. They are the men whom industry has given various titles, but who may be designated generally as the product engineers.

NEW MATERIALS AND PARTS

And Engineering Equipment

"American" Flexible Coupling

The American Flexible Coupling Company, Erie, Pa., is marketing a shaft coupling which is a variation of the Oldham type. The floating center member of the "American" flexible coupling is a square, hollow casting, with a hole in the center to provide clearance for the shaft ends. To the edges of this floating member are fastened replaceable bearing strips made from a hard, tough, non-metallic compound. The flange sections are identical and interchangeable, except for the bore diameters, which are made to suit the shafts.

"American" Flexible Pulley

The flange is cast in one piece with a hub of ample dimensions. A wide groove is machined in the face of the flange, leaving two jaws between which the floating member slides, and by which the torque is transmitted.

The coupling can be removed without the use of special tools by simply pulling the jaw flanges apart horizontally or sliding them past each other vertically. The non-metallic bearing strips can be replaced in a few minutes when necessary without disturbing the coupling or the connected shafts. The bearing strip screws are removed through holes in the jaws, after which the old strips can be slipped out and new ones inserted.

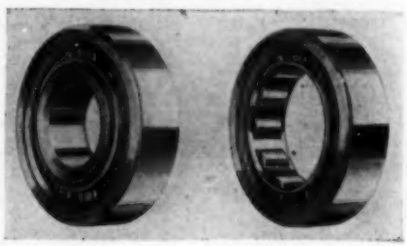
The floating hollow center member is filled with grease which passes to the surfaces of the wearing strips through suitable channels fitted with wicks. In operation, centrifugal force assists proper lubrication. By means of an ordinary grease gun the center member can be filled with fresh grease through any one of the bearing-strip screw holes.

It is stated by the manufacturer that the coupling provides maximum flexibility without the use of flexible materials, and that the device does not deteriorate rapidly when subjected to moisture, heat, and dirt. The coupling is avialable in bores from $\frac{3}{4}$ to 12 and in light- and heavy-duty types. The horsepower transmitted ranges from 0.50 to 1,000 hp. at 100 r.p.m. Both nickle cast-iron and steel couplings are available. The weights range from 6 to 3,200 pounds.

Hyatt Single-Row Radial Bearings

To meet the demand for a roller bearing interchangeable with standard S.A.E. single-row ball bearings, but having greater load capacity, the Hyatt Roller Bearing Company, Newark, N. J., is now manufacturing single-row radial bearings. This line, having solid rollers, is not intended to replace the standard Hyatt roller bearing which uses spirally wound rollers, but is offered as a supplement to it, for positions in which space limitations exist, and loads beyond the capacity of ball bearings must be sustained.

The design employed is one in which the rollers are permanently retained with the outer race, the inner race being separable. A separator, floating on the rollers, spaces them properly, and heat-treated end rings retain them endwise within the outer race. The end rings and separator function to keep the rollers in proper alignment insuring positive contact along their full length. The rollers and races of this bearing are made of a special chrome-nickel alloy steel, and the end rings are of vanadium steel to minimize wear by the ends of the rollers. The roller separator is so made that the pockets are parallel and equally spaced, thus assuring uniform load distribution on the rollers.

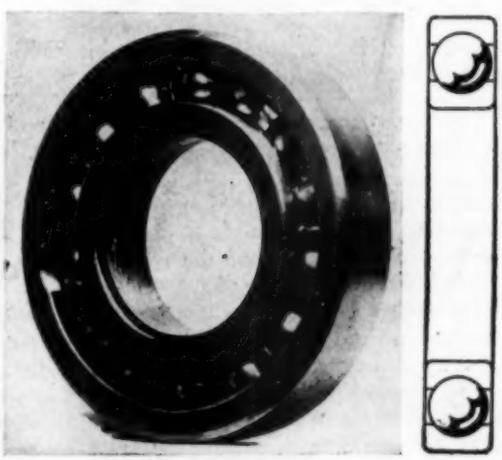


Hyatt Single-Row Radial Bearing illustrated at the left assembled with the inner race and at the right with the inner race removed to show the roller construction

It is claimed that the possible separation of this bearing into two parts, the inner race being removable, offers opportunities of developing more economical methods of assembling for all applications with or without the inner race. The roller ends are sufficiently rounded to facilitate assembly where the inner race is not used and both the outer and inner races are chamfered at one end. The single-row radial bearings are now in regular production in a range of size.

Fafnir S Series Airplane-Type Ball Bearings

The Fafnir Bearing Company, New Britain, Conn., has announced that a series of ball bearings adapted for plane control mechanisms has been made available to manufacturers. These bearings, known as the S



Fafnir S Series Airplane-Type Ball Bearing

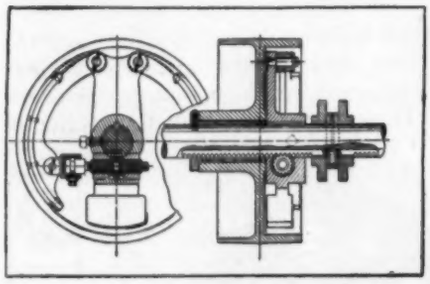
Series, are of the single-row radial type with inch dimensions and narrow widths. They are available in bores from ¼ to 1 in. as follows:

Bearing	Bore	Outside Diameter	Width
S 1	¼	¾	7/32
S 3	⅜	⅞	7/32
S 5	½	1⅛	¼
S 8	¾	1⅝	9/32
S 8	¾	1⅝	5/16
S 9	⅞	1⅞	⅜
S 10	1	2	⅜

The narrow-series ball bearings are made of chrome-molybdenum steel, hardened and ground throughout.

"Duro" Friction-Driven Countershaft

The Duro-Friction Clutch Company, Grand Rapids, Mich., has announced the friction-driven countershaft illustrated below. The mechanism is simple in design and all parts are of standard construction. A feature of the design is the means for expanding the friction shoes, which have self-equalizing action to take care of wear. Expansion units are made up of right- and left-hand special studs, which are engaged in the hub of the spur gear. As the rack is moved either to the right or to the left, the spur gear revolves and



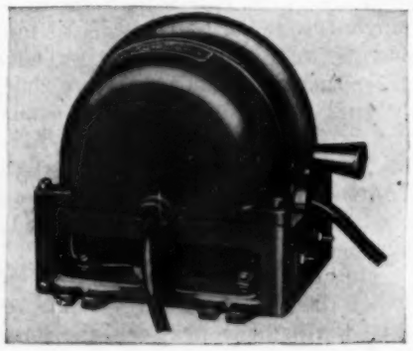
"Duro" Friction-driven Countershaft

forces the two threaded members outwards, and this causes a positive contact of the shoes upon the friction surface inside the face of the pulley. The contact is claimed to be positive, but not subject to severe shock.

When the friction shoes wear down to about 5/16 in., they do not require adjustment because the spur gear face is 5/16 in. wide and the rack face is ⅝ in. wide, thus giving the spur gear 5/16 in. of equalizing travel to take care of the wear upon the shoes. When this amount of wear has occurred, an extension of the hub for about 5/16 in. becomes noticeable and adjustment may be effected. When the friction shoes must be repaired it is only necessary to take out the shoes and replace the face material. The main bearing for the driven pulley is self-lubricated.

Taft-Peirce Field Discharge Switch for Magnetic Chucks

An improved field discharge switch has been announced by the Taft-Peirce Manufacturing Company, Woonsocket, R. I. The switch is designed to dissipate the high voltage surge induced in the windings of an unprotected circuit when the operator of a magnetic chuck throws the switch. By the use of this device, the puncturing of coil insulation is prevented. It is now regular equip-

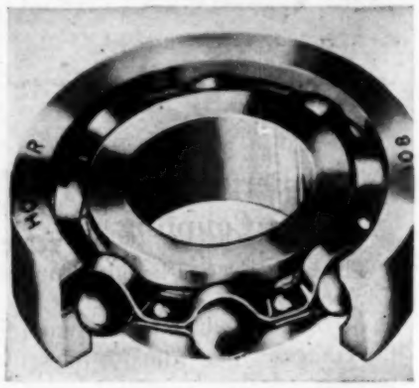


Taft-Peirce Field Discharge Switch for use with "Superpower" Magnetic Chucks

ment on all Taft-Peirce "Superpower" chucks of size 1,134 and larger and may be had for replacement on any magnetic chuck installation.

Hoover Single-Row Annular Ball Bearings

Deep-groove, no-notch construction to withstand heavy thrust and radial loads at high speeds is a feature of the line of single-row annular bearings introduced in standard sizes by the Hoover Steel Ball Company, Ann Arbor, Mich. Both the raceway and the balls are made of high-carbon,



Hoover Single-Row Ball Bearing

chrome alloy steel, produced by the electric furnace method. The retainer is made of deep-drawing steel, riveted. The balls are of the "Hoover Micro-Chrome Grade," accurate to within 0.00005 in., and the raceways are ground and polished to a similar finish. The bearings are available in three series, light, medium, and heavy, ranging for the lighter series from 0.3937 in. to 4.7244 in. bore, and for the heavy series from 0.6693 to 3.9370 in. bore.

"National" Draftsman's Pen-Filling Inkstand

Designed to take a ¾-oz. glass ink bottle of any make, a draftsman's pen-filling inkstand has been developed by the National Tool Engineering Company, P. O. Box 712, Indianapolis, Ind. The bottle is held in place by a steel spring clip which fits around the body. The top of the device swings back and stays up so that the stopper can be put back in the bottle when the ink is not in use. However, a soft flexible rubber

"National" Draftsman's Pen-Filling Inkstand

pad on a swivel joint in the top keeps the bottle tightly sealed, regardless of the difference in height of various bottles. The base contains two holes, one on each side, to accommodate different sizes of stoppers.

To use the device, the draftsman pushes the ring down with the little finger and applies the ruling pen to the filler pen. The top then drops into place, sealing the bottle. The filler pen can be adjusted for depth. The same stand can be used for different colors by simply changing the bottle and filler pen. The latter is a standard type fitted into a standard pen holder and can be changed quickly and easily.

The body, ring, and top of the pen-filling inkstand are of gray iron castings and are finished in gold crystal baked enamel. The weight is about 1¾ lb., which is sufficient to prevent the device from tipping over accidentally while on the draftsman's table.

General Electric Planer Control Apparatus

To meet the demand for control equipment that will allow all automatic operations of a planer to be governed from a pendant push-button

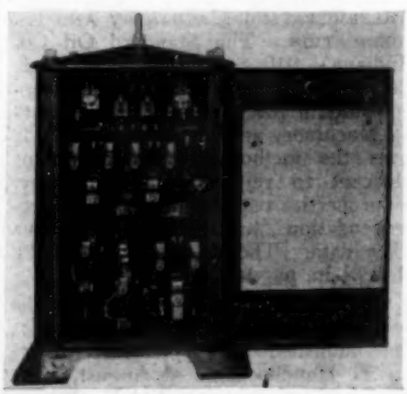


Fig. 1—General Electric Type CR-4602-L-5 Magnetic Controller for remote control of planers by push button

station, the General Electric Company, Schenectady, N. Y., announces a magnetic controller and push-button station, designated CR-4602-L-5 and CR-2940-BC-14, respectively. The panel, Fig. 1, is of standard design with an added section on which are mounted the relaying contactors governed by the push-button station.

Fig. 2—General Electric Type CR-2940-BS-14 Push Button for remote control of planers

This extra section may be added to standard pedestal type magnetic controllers now in service.

The pendant push-button station, Fig. 2, has four buttons: "Automatic," "out," "return," and "stop." The "start" button is located at the controller itself, but, after pressing the stop button at the pendant station, operation may be resumed by pressing the automatic button. The stop button is at the bottom of the station, readily accessible from all angles. The push-button station is very light, is approximately 2 in. wide, 6 in. high and 2¼ in. deep.

In operation, pressing the start button in the door of the main panel closes the circuit breaker contactor. The automatic button is then pressed, but operation does not start until either the out or return button is pressed, depending on the desired running direction. If the wrong button is pressed for the position of the planer at that time, nothing will happen.

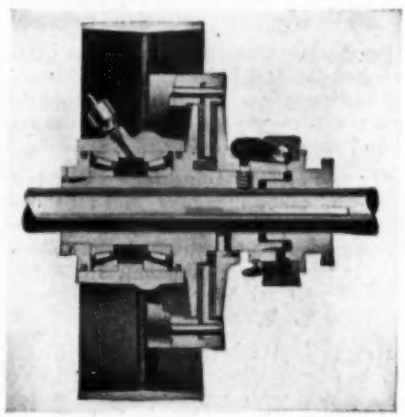
The outstanding advantage of the control is that, when machining large castings, it is not necessary for the operator to do needless walking around every time it is desired to operate the machine. He has full control from the pendant push-button station.

Tuthill Models MS, RS, and CS Lubricant Pumps

To supply the demand for pumping equipment to handle lubricating, coolant, and hydraulic service on machine tools, the Tuthill Pump Company, 131 W. 63rd St., Chicago, Ill., has placed on the market modified forms of its Models M, C and R pumps known as Models MS, CS and RS, for these specific purposes. The pumps can be built into the construction of machines instead of being mounted on pads or pedestals. These pumping units can be applied to almost any mechanism, with the simplest form of adapter.

Edgemont Type SF Disk Clutch

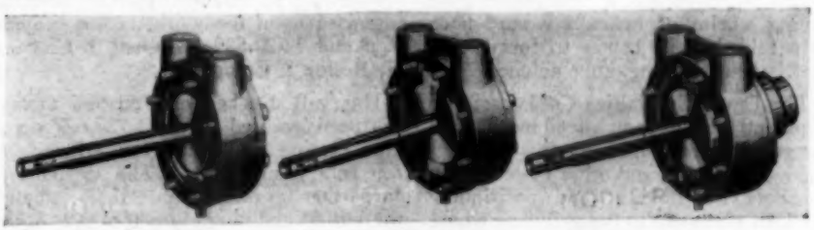
Intended for both countershaft and machine applications, the type SF disk clutch has been announced by the Edgemont Machine Company, 2200 Home Ave., Dayton, Ohio. A



Edgemont Type SF Disk Clutch

complete line of clutches with pulleys is manufactured. Features are oil sleeve bearings, a choice of Timken tapered roller bearings or Fafnir transmission ball bearings, extended sleeves for mounting pulleys, sheaves and gears, and cut-off couplings for connecting and controlling two shafts. Special pulley, sprocket, sheave and gear blank applications are made to order. Mechanisms are furnished to those desiring to make their own mountings only.

The single adjustment consists of



Tuthill Models CS, MS, and RS Lubricant Pumps

pressing down on the locking lever and turning the adjuster until the locking lever snaps into the next slot. The device is furnished with renewable asbestos metallic liners of large friction area, a hardened steel cam and rollers, and means for effecting a quick release without dragging. The clutch may be operated at high speed because of the improved design of the levers and better balance. It is claimed that centrifugal force will not cause the moving parts to engage the clutch nor cause dragging at any speed. The levers push on the plate without sliding action, thus doing away with wear at that point. Easy operation is assured by the rollers in long levers and there is no sliding under heavy pressure.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Parts and Mechanisms

William J. Andres, of South Bend, Ind., has been granted patent 1,724,897, on a lever movement combining an arm with fixed leverage, a variable lever actuating the arm, and means for varying the leverage by shifting the fulcrum.

To the B. F. Sturtevant Co. has been assigned patent 1,724,902, on a ball bearing having a casing with oil compartments, and means for circulating the oil to and from the bearing.

A roller clutch having rollers between inner and outer members, and an independent lock-ring with yielding inclined surfaces against which the rollers lock, is the subject of patent 1,724,983, granted to Carl W. Weiss, of Brooklyn, New York.

Ralph J. Winterbottom, of Sparta, Ill., has been allowed patent 1,724,985, on a piston with screw-threaded bosses and pin-bushings. The pin-bushings have tapered bores adapted to fit the corresponding tapered ends of the wrist-pin.

To the Twin Disc Clutch Co. has been assigned patent 1,725,016, on a clutch that has floating clamping-disks on opposite sides of a friction plate, and means for operating the disks by pivoted levers linked to a hub.

A one-way automatic spring clutch, comprising co-axial drum clutching surfaces, a helical spring, and other co-operating parts, is the subject of patent 1,725,109, assigned to the L. G. S. Devices Corporation.

The Westinghouse Electric & Manufacturing Co. is the assignee of patent 1,725,124, covering a composite gear having a rim of helically-wound fiber strip folded at its center to form adjacent layers with engaging notches.

The Danly Specialties Co. is assignee of patent 1,725,444, on a feed mechanism for grinding machines, having a swinging work carrier, and other co-operating elements for holding and positioning work in reference to the grinding wheel.

To the Buffalo Steam Pump Co. has been assigned patent 1,725,303, covering means for lubricating upright bearings, and including an arrangement of scoops for lifting oil from a lower to an upper reservoir.

A chuck, for automatically centering gears, or the like, that comprises a head, an internal gear therein adapted to receive telescopically the gear to be centered, and that has also a means for applying yieldable pressure against the teeth of the gear, is the subject of patent 1,725,342, asisgned to Susan D. Copeland, of Birmingham, Michigan.

Patents 1,722,808-9, assigned to the Stewart-Warner Corporation, relate, respectively, to a filter arranged so that it will move when clogging causes a predetermined rise in pressure, and thereby remove sediment, and to a magazine filter and still with means for removing a fluid inlet member.

Patents 1,722,488-89-90 and 91, relating to refinements in ball bearings and means for inclosing said bearings, have been assigned to the Norma-Hoffman Bearings Corporation.

To the Hess-Bright Manufacturing Co. has been assigned patent 1,722,492, for a ball bearing with inner and outer races of such different axial thickness that the same force is required to bring the races flush at either side.

The Skayef Ball Bearing Co. is assignee of patent 1,722,493 on a double-row taper roller bearing with a novel arrangement of inner and outer races.

A work-feeding device for vertical disk grinders, having a plurality of vertically adjustable plates bearing edgewise upon the work, is the subject of patent 1,722,589, assigned to Charles H. Besley & Company.

Harry R. Decker, of Houston, Texas, has been granted patent 1,722,627 on a pipe cutting and threading attachment for rotary machines. The device incorporates a rotary table that actuates the cutter and threading tool.

TRADE PUBLICATIONS

BRASS AND COPPER. The Chase Brass & Copper Co., Inc., 80 Lafayette St., New York, has published a booklet showing the equipment necessary to make and distribute brass and copper. The booklet illustrates distribution facilities and personnel of the company. It contains forty-eight, 3½ by 6½-in. pages.

CHAIN DRIVES. The Ramsey Chain Co., Inc., Albany, N. Y., has published industrial catalog No. 628 on Ramsey silent chain drives, giving the field of application and photographs of actual installations. Design data and many tables are listed. The catalog contains 87, 9¼ x 6-in. pages.

INDUSTRIAL HEAT, ELECTRIC. The Public Service Company of Northern Illinois, 72 West Adams St., Chicago, Ill. has published a booklet entitled "Electric Heat for Industry," giving an illustrated picture of the use of electric heat in various modern industrial applications. The booklet contains thirty-six, 8½ by 11-in. pages.

LUBRICATION. Lubrication Devices, Inc., 50 South Washington St., Battle Creek, Mich., has published a 16-page, 8½ by 11, booklet entitled "A Picture Story of Farval." The booklet illustrates installations of Farval pressure lubricating systems in various industries, and under varying conditions.

REFRIGERATING MACHINERY AND ITS LUBRICATION. The Standard Oil Co. (Indiana), 910 South Michigan Ave., Chicago, Ill., has published Engineering Bulletin R-79, entitled "Refrigerating Machinery and Its Lubrication." It gives the methods of application of lubricant to refrigerating machinery, the properties required, and various recommendations, together with numerous other data. The catalog contains 26, 11 x 8½-in. pages.

S.A.E. HANDBOOK SUPPLEMENT. The Society of Automotive Engineers, Inc., has published a supplement to the S.A.E. Handbook, dated August, 1929. The booklet contains S.A.E. recommended practice, diagrams, and tables, for the use of the industry. The booklet contains eighty-four, 4¼ by 7¼-in. pages.

STEEL, NICKEL-ALLOY PRODUCTS. The International Nickel Co., Inc., 67 Wall St., New York, has published a Buyers' Guide for nickel-alloy steel products, dated July 1, 1929. The booklet contains a list of firms manufacturing the items most frequently called for, which are now made of nickel-alloy steel. The booklet contains twelve, 8½ by 11-in. pages.

NEWS
OF THE WEEK

National Machine Tool Congress to Hold Four Technical Sessions

Several companies to feature special tools for rapidly developing aircraft industry

FOUR evening sessions and a banquet are scheduled for the National Machine Tool Congress to be held in Cleveland from Sept. 30 to Oct. 4, during the National Machine Tool Builders' Exposition. All sessions will be held at the Hotel Cleveland. The first two are being sponsored by the Machine Shop Practice Division of the A.S.M.E., while the Wednesday and Thursday evening sessions are being sponsored by the Production Division of the S.A.E. The dinner Friday night, Oct. 4, is an entertainment arranged by all the participating groups.

"What Information Does the Machine-Tool Buyer Need from the Machine-Tool Salesman" will be the topic of the Monday evening session. G. T. Trundle, Jr., president of the Trundle Engineering Co., Cleveland, has made a survey of this question and is presenting the paper for discussion. Phillip E. Bliss, president of the Warner & Swasey Co., will be the presiding officer. The Tuesday evening session will be given over to Dr. Zay Jeffries of the General Electric Co., who will present a paper on the "Present Status of Cemented Tungsten-Carbide Tools and Dies." Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt., will be the presiding officer. These two sessions have been arranged by the Machine Shop Practice Division of the A.S.M.E.

Wednesday evening, Prof. F. E. Raymond, of the Massachusetts Institute of Technology, will present a paper on "Economic Production Quantities." Prof. Raymond is Secretary of the Research Committee of the A.S.M.E., which has been making an extensive study of this problem. The Thursday evening session will be given over to round table discussion on the following subjects: "The Application of Standard Machine Tools to Automobile Manufacture," "Results in Production Due to New Features of Machine-Tool Construction," "Synchronizing Automobile Parts at the Assembling Line," and "The Basis of Replacing Machine Equipment." These last two sessions are sponsored by the S.A.E.

The sessions will be held in the ballroom of the Hotel Cleveland and will commence at 8 p.m. The dinner will also be held in the ballroom, but will commence at 6.30 p.m., on Friday evening.

Indicative of the interest being displayed in new tools for the aircraft industry is the display of the Kearney & Trecker Corporation. The booth of this company will contain machines milling master rods, baby rods, crankcases, and similar parts for airplane engines. Airplane engines, beacon lights, and other accessories will be shown, and a plane has been chartered by the company to take customers for rides over Cleveland and to and from the show.

* * *

Cadillac Opens $1,000,000 Engineering Building

A $1,000,000 engineering building, erected as part of a $5,000,000 expansion program begun last spring, was opened on Aug. 7 by the Cadillac Motor Car Co., Detroit, Mich. General Motors executives and other automotive engineers inspected the building on that day. Research and design facilities not duplicated anywhere, are claimed to be included in the building, which comprises a complete automobile factory and an engineering department. E. W. Seaholm, chief engineer, designs and builds original and experimental Cadillac and LaSalle models, assisted by a staff of 300 experts in scientific research, covering metallurgical, chemical, and engine-design divisions.

In the four-story laboratory are 129,000 sq.ft. of floor space. The departments include an experimental garage, electrical and general test laboratories, including a dynometer room with seven machines, a machine shop with $350,000 worth of equipment, drafting rooms and a body department including sheet-metal work and clay modeling.

* * *

American Worker Gets Highest Wages

Labor in the United States, both skilled and unskilled, for both men and women, is the highest paid on the face of the earth, according to L. C. Harbison, president of Household Finance Corporation, New York. As a result of the study of the findings recently made from 1928 statistics, Mr. Harbison said, "Skilled workmen in the United States earned an average of 66 cents an hour and unskilled men 49 cents. The average for all was 57 cents; women 40 cents. Using 100 as the index figure for pre-war pay, the United States is now paying 245 for skilled labor and 236 for unskilled labor."

* * * *

Several Outstanding Achievements Noted In Aeronautical Field

SEVERAL noteworthy achievements were recorded during the month of August, both by heavier- and lighter-than-air machines. The Cleveland Air Races, the Schneider Cup Races in England, the Guggenheim competition, and the flight of the Graf Zeppelin contributed materially to these achievements.

Perhaps most noteworthy among the achievements in design is that of the ZMC-2, first all-metal dirigible, which was built for the U. S. Navy at Detroit by the Aircraft Development Co. of that city. This craft is 150 ft. long and 50 ft. in diameter. Such dimensions are an innovation in lighter-than-air craft, inasmuch as the length of dirigibles built heretofore has been seven times greater than the diameter. The new ship has a gas capacity of 200,000 cu.ft., and uses non-inflammable helium instead of hydrogen. It is propelled by two Wright Whirlwind engines of 225 hp. each. Builders of the craft expect it to develop a speed of 62 miles an hour. A cruising radius of 680 miles at 50 miles an hour is claimed for the dirigible. The ZMC-2 has cabin room for three passengers in addition to room for a crew of three. Although said to be too small to be of any great naval or military value, this ship is expected to provide data for the construction of other ships of the same type with gas capacities from 10 to 20 times greater. The frame of this dirigible is covered with a comparatively new metal called Alclad, very resistant to corrosion, and only 95/10,000 in. in thickness. The covering is made of long,

narrow curved strips of this metal, stitched together by a sewing machine using wire instead of thread. This covering is laced onto 12 circular latticed frames of triangular section. These are stiffened by wires placed diametrically across the hull's interior. The cabin of the craft is built of corrugated Duralumin, streamlined.

Juan de la Cierva, Spanish engineer who invented the Autogyro, brought it to this country to be shown as a feature of the Cleveland Air Races. Great safety is claimed for this plane in addition to its ability to drop almost vertically from the skies and to land safely if the motor should fail suddenly. A feature of the Autogyro consists of four large propeller-like blades which revolve in a horizontal plane above the cockpit, and a specially constructed tail embodying two horizontal stabilizers. The plane lands slowly on tail skids, the rest of the weight settling later on the rubber-tired landing gear.

WILL CONSTRUCT NEW ZEPPELIN

Dr. Eckener, designer of the Graf Zeppelin, together with his chief engineer, Dr. Duerr, is planning the construction of a new zeppelin at Friedrichshafen as soon as the hangar now under construction is ready. The new ship will be the same length as the Graf but will be of greater beam and will have an additional capacity of 45,000 cubic meters. This ship will be ready for service by the middle of next year, when, according to present hopes, it will be placed in regular European-American or European-Japanese service.

Even though the American Schneider cup entry failed to pass the Navy requirements, some unusual developments have been embodied in the plane that will be utilized in constructing future planes for similar events. The Italian and British entries also are utilizing many features which will be tested for practicability. Innovations in streamlining, special metals, special motors, and entirely inclosed cockpits are embodied in several of the models.

Chief among the British entries is the super-marine Rolls-Royce S-6, which embodies several changes in design and construction reported to give the plane a speed of something over 360 miles per hour. The plane is streamlined throughout and has its cockpit mounted above the single wing. The Golden Racer, a Gloster-Napier-6 Schneider Cup plane, another British entry, will have the pilot completely inclosed in a tiny cockpit. Italian planes have been so recently completed that no outstanding features of design have been announced.

Several attempts to design a super-safety plane have been made in the competition for the Daniel Guggenheim prize in the safe aircraft competition at Mitchel Field which takes place this Fall. Among them is the new Handley-Page plane which incorporates an automatic wing slot. This slot enables the plane to rise so steeply that the tail almost sweeps the ground in the upward climb, tilted at least 45 deg., an angle of climb unheard-of in a normal machine. A second device, operated in conjunction with the wing slot, consists of a lateral hinged fin placed along the top of the wing just behind the leading edge which can be raised or lowered by the pilot, thus breaking the vacuum sustaining the wing should the plane start to fall off on the other wing. This device is used in addition to the wing slot and later improvements have made its operation automatic.

* * *

Air Transport Lines Make Notable Gains

Notable developments have been made in aerial transportation during the past three years, according to "Domestic and Foreign Affairs," bulleting of the Commission on Commerce and Marine of the American Bankers Association. According to the report on March 30, 1929, air transport routes within the United States totalled 16,950 miles, connecting approximately 368 cities with direct air service. Some of the lines carry mail, passengers and express, while others carry only one or two of these items. Foreign routes, totalling 4,442 miles with one terminus in the United States and newly scheduled routes totalling 6,537 miles make a grand total of routes in operation now scheduled for early operation of 27,929 miles. There is a daily scheduled average of airplane miles with mail of 39,216; of non-mail service 18,300; or for all services, 57,516 miles. On some of these routes express is carried under contract.

It is estimated that approximately 80 millions of miles are now flown annually by air transport services and air transport in the United States. From 1927 to 1928 air mail poundage tripled. Passenger traffic increased 420 per cent in 1928 as compared with passenger traffic in 1927, and the number of passengers carried during the latter year was almost 53,000. More than 800 concerns are engaged in air service work, such as photography, mapping, crop dusting, advertising, flying instruction and miscellaneous activities. South of the United States 10,075 miles of air routes are regularly operated and from present indications this mileage will be increased rapidly. Over 90 airplanes are in regular operation in these services, about half of them being manufactured in the United States.

* * *

Corporation Profits Show Big Increase

According to the revised figures on corporation profits issued by the National City Bank of New York, in its September bulletin, corporation profits for the first six months of the year increased 27 per cent over those of the corresponding period of 1928. Combined net profits of over 900 corporations whose reports have now been issued aggregate $2,449,000,000 for the first half of the current year as compared with $1,924,000,000 in the corresponding period in 1928. Automobile corporations taken collectively showed a 4.1 per cent increase in profits for this year, while auto accessory manufacturers showed an increase of 62.4 per cent and aviation corporations showed an increase of 66.2 per cent over the earnings of the same period last year. The electrical corporations showed an increase of 36.5 per cent in profit, the iron and steel industry showed an increase of 102 per cent, machinery corporations showed an increase of 54.7 per cent, railway equipment corporations showed an increase of 42.2 per cent, and railroads proper showed an increase of 21.9 per cent in corporation earnings for the period as compared with the earnings of the same period last year.

* * *

Austin to Build Huge Soviet Automobile Plant

Official confirmation of the award to the Austin Company of a contract for the design and construction of a huge automobile plant for the Soviet government at Nishni Novgorod, Russia, was received recently by W. J. Austin, president of the company, by cablegram from G. A. Bryant, Jr., vice-president, who negotiated the contract. The sum of $20,000,000 is involved in the project that the Austin company will carry through. The plant will be designed to produce 100,000 Ford cars annually, and the Ford Motor Company will provide technical assistance in the equipment of the plant and assist in the manufacturing operations when the plant is completed. A power house, foundry equipment plant, and a complete automobile plant, on a site consisting of 5,000 acres are called for in the contract. The concern is expected to employ 25,000 people.

* * *

American Grinder Exports Increase

Exports of American grinding machinery, according to a recent statement by the U. S. Department of Commerce, show a continued increase. Great Britain and France are, at the present time, the leading importers of American grinding equipment, Great Britain having taken 60 external, internal, surface, and tool grinding machines during the month of May, and France having taken 40 during the same period. France also purchased other mechanical grinding machines valued at $27,500, while Great Britain purchased other grinding machines valued at $10,000 during that same month. Italy, Belgium, and Germany also imported considerable amounts of grinding machinery.

Annual Economic Contest Announced by Simonds

Alvan T. Simonds, President of the Simonds Saw and Steel Co., Fitchburg, Mass., has announced the subject for his eighth annual economic contest to be "The Federal Reserve System and the Control of Credit." Two prizes are offered for the best papers, a first prize of $1,000 and a second prize of $500. The contest closes Dec. 31, 1929, and is expected to arouse a more general interest in the subject of economics as related to individual and general welfare, to develop a better understanding of the application of economic principles to business, and to secure a clear and forceful statement of how credit effects the prosperity of the country and the world.

* * *

Reception Committee for World Congress Announced

A New York reception committee of the American Committee of the World Engineering Congress has been appointed to receive delegates to the Congress who enter this country. Members of this research committee will be assisted by so-called "minute-men" from the four Founder societies. The reception committee proper consists of 20 men having as chairman Roy V. Wright. Calvin W. Rice, Secretary of the A.S.M.E., and F. R. Low, Editor of *Power*, a McGraw-Hill publication, are included on this committee. Other McGraw-Hill men included among the minute-men of the various societies are: K. H. Condit, Editor, *American Machinist*, A. D. Blake, *Power*, R. D. Hall, *Coal Age*, H. L. Johnson and H. D. Keiser, *Engineering & Mining Journal*, and L. W. Morrow, *Electrical World*.

* * *

Aircraft Exports Show Huge Increase

Foreign trade of the aeronautical industry is growing at such a rate that total exports for the year are likely to exceed the combined total exports for the previous four years, in the opinion of Dr. Julius Klein, Assistant Secretary of Commerce. Exports last year amounted to $3,500,000, and for the first six months of 1929, amounted to $6,000,000, which in Dr. Klein's opinion, indicates that the American export trade in aircraft will soon become an important factor in foreign commerce.

Exports of airplanes in 1928 went to 22 countries, and were largely military planes, many of them being purchased by the Latin-American countries. Lately, however, the character of the equipment exported has changed, and now most of the planes sent from the United States are for commercial use, many of them of the large passenger transport type. A Chinese company has purchased several planes of this type to be used for passenger service between Tokio and Shanghai, a distance of 1,150 miles.

* * *

Novel Locomotive Tested in Canada

A new type of oil-electric locomotive, claimed to be better than the steam locomotive, was tested recently between Montreal and Toronto. Cost of fuel used was but $25, in comparison with a cost of $80 for the coal-burning locomotive on the same trip. The engine is in two articulated units, each driven by a 12-cylinder Diesel engine. Heavy oil is used for fuel, and is burned by a progressive explosive process. The oil engine drives an electric generator, which in turn moves individual motors that turn the four pairs of driving wheels on each unit.

Oakland Motor Car Co. Makes Appointments

W. B. Sawyer, formerly Eastern sales manager for the Oakland Motor Car Co., Pontiac, Mich., and W. E. Fellows, formerly advertising manager, have been appointed assistant general sales managers. Hugh Higginbottam, formerly assistant to W. R. Tracy, vice-president in charge of sales, succeeds Mr. Sawyer as Eastern sales manager, and H. E. Mahaffey, formerly Chicago regional manager, becomes western sales manager. Grady Gamble, formerly Dallas, Tex., zone manager, succeeds Mr. Mahaffey as Chicago regional manager, and C. L. Voss, formerly Chicago zone manager, becomes Dallas zone manager, and is succeeded in Chicago by E. M. Lubeck. C. S. McElwain, formerly assistant advertising manager, has been named acting advertising manager.

* * * *

Washington Looks at Unemployment—The Merger Tendency—Navy Shops at Work—Human Displacement by Machines

By Paul Wooton
Washington Correspondent, American Machinist

WASHINGTON, D. C., Sept. 11—A census of unemployment has been authorized by Congress as a part of the decennial count of the population. So that a wrong impression of the "jobless" will not cast a shadow on the bright picture of prosperity, the authorities intend to prevent careless enumerators from reporting persons as out of a job who really do not merit that distinction.

Dissatisfied papas, who may be cutting lawns because they have been laid off at the mill, should not be classed as out of a job. Mammas and daughters who may work part-time to earn a little pin money or to pull papa out of the hole do not properly belong in the ranks of the unemployed when not so engaged. Youngsters looking for their first job with cap and gown under arm certainly should not be included in the total. Fastidious gentlemen of the road and those resting at home who regard labor as undignified might be offended if they were reported as seeking employment. Others who have some professional standing as job seekers may be disappointed because they are ignored.

There is a very general recognition that it is better to have real competition between a few large corporations than between a multiplicity of high-cost units, but there is some apprehension lest the combining may not be done in an orderly manner and on a sound basis. Some of the Senators, now re-assembled, are sure that the commission on financial operations constitutes the chief incentive for many mergers and they are not sure what will happen after the promoters get their money.

It does not appear that the navy yards have suffered very much thus far because of suspension of work from cruiser limitation. Moreover, the Philadelphia and Puget Sound yards are so well fixed with other work exclusive of the new cruiser program, that they would not be seriously inconvenienced for some time even if construction should be canceled. The Philadelphia yard has a large modernization program under way and the Puget Sound station is busily occupied with the construction of the light cruiser Louisville.

Technological unemployment constitutes a new and difficult problem, in the opinion of the President of the American Federation of Labor. He says: "We realize that improved machinery and the use of power is the inevitable development of modern industry and that machine displacement will continue in conformity with the application and study of inventive minds. We see in it all a relief from the effects of human drudgery and excessive toil, but we must not be unmindful of the serious social and economic condition created because of human displacement.

"Serious-minded people, possessing a keen appreciation of the serious stage which this problem has reached, are thinking about it and about its destructive consequences. It is to be regretted that this question has not commanded more universal attention and consideration."

BUSINESS BAROMETER

Widespread scarcity of credit is becoming the most conspicuous feature of business both here and abroad

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

BANKING news last week, both here and abroad, laid fresh emphasis upon the widespread scarcity of credit that is becoming the most conspicuous feature of the situation. One influence was the fear that the Bank of England would raise its rate to 7 per cent. The raise was not made last week, and the tension was somewhat relieved, but most students of the situation think the step is merely deferred, for it may be taken for granted that the willingness of American speculators to pay 8 or 9 per cent for call money with which to carry stocks ultimately will draw most of the world's unemployed capital to this market and intensify the shortage elsewhere.

Of even more concern is the apparently unending growth of brokers' loans in this country. During August, borrowings by the members of the New York Stock Exchange showed the unprecedented increase of $407,825,000 to a new high total of $7,881,619,000. The loans to brokers reported by the New York member banks of the Reserve System jumped $137,000,000 last week, making a total increase of more than $400,000,000 during the past three weeks.

At a time when more money is needed to finance crop-moving and the seasonal expansion in distributive trade which begins after Labor Day, it is idle to think that the securities market can continue to gulp such huge weekly bites without starting a drain on the Reserve Banks, and the figures suggest that some liquidation is presently inescapable. Hence the stock market had some violent sinking spells last week, brokers are commencing to issue letters calling attention to the fact that the security issues that have declined since the first of January outnumber those that have advanced, and the feeling that pervades speculative circles is rather more cautious than it was.

In the commodity markets there have not been many changes that are important in their significance. In cotton there has been a thermometric and a barometric market. August brought the usual crop scare, but it seems to have exhausted itself, and prices yielded when scattered rains were reported. The inventor of an infallible instrument for forecasting the weather throughout the cotton belt could make an enormous fortune if he had the nerve to operate upon the forecasts obtained.

Other commodity markets have been mostly steady to firm. This is particularly true of silk, which is sustained by a high consumption and the seasonal falling off in shipments from Japan, and of sugar, in which the unsold balance of the Cuban supply has been taken over by a single selling agency that will not accept present bids. The grains are still nervously waiting for export buying to absorb the temporary surplus.

A renewal of strength in copper is beginning to attract attention. It was marked up to 18¼ cents after Labor Day and some predict that it will go to 20 cents. Copper is a "managed market." The last advance was overdone, but buying has now picked up again and the producers are in a position to try once more for better prices. No significant change has appeared in industrial reports. Most of the big industries are below their peak, but still exceptionally active and confident though the likelihood of curtailment in automobile and tire manufacturing is obvious.

From overseas, the news is encouraging. Philip Snowden has returned to England in triumph. His settlement of the controversy that arose at the Hague has increased his popularity, and strengthened the hold that the Liberal Party has upon the country.

The news from Palestine and Arabia is also reassuring, and the Arabs appear to be showing a more accommodating disposition toward both the Jews and the English. There is no doubt, however, that their change of attitude was brought about by the promptness with which the English resorted to the use of their army and navy when it was necessary, and it is feared that the result will have the effect of making it a little more difficult to disarm all nations.

The row between China and Russia that threatened seems to have evaporated, at least in so far as the news dispatches are concerned. The four hundred million people who inhabit China are the most industrious group in the world, individually considered, and it is a great pity that they cannot be occidentalized, if such a word is permissible.

In so far as this country is concerned, the outlook seems entirely satisfactory. Legitimate trade is good. If the stock market declines there may be some slack to take up, but this is about the only possibility that suggests the need of caution, and there seems to be every reason for expecting a good business next winter if we get through the crop-moving period without having to pay painfully high rates for credit.

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From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

THE approach of the National Machine Tool Builder's Show at Cleveland has brought about a period of expectancy, and is exercising somewhat of a restraining effect upon purchases of machinery and tools. Prospective purchasers are holding up purchases wherever production demands are not too great to await the show and the improved machines and machine tools which it will bring forth. This factor has equalized business resulting from deferred orders which are now coming in after awaiting the signature of officials on vacation for the past several weeks. Deliveries are holding their own, but there has been very little improvement; in fact, the back logs in plants have occupied the time of engineering and production staffs to such an extent that the new tools being developed for the Show have been seriously hampered. Prices have not increased during the past few weeks, even though price increases have been predicted.

RAILROAD buying and inquiries were the most important features of the New York and Chicago market. Detroit business conditions are improving rapidly, and inquiries from automobile and accessory manufacturers are being received. Philadelphia business is up to expectations, with industrial plants, airplane, radio, and ball bearing manufacturers doing the buying. Milwaukee business pending is high, and inquiries are on the increase.

CLEVELAND purchasers are marking time until the show; orders are poor, and inquiries little better. New England reports an August business below that of July. Cincinnati fears a labor shortage, but anticipates a good month in orders booked. The feeling is general that 1929 will be a record year in the industry.

THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine-tool business

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW YORK

Railway rolling stock occupied the prominent place in the machinery and machine-tool market in New York during the past week. The New York Central Railroad placed orders for 35 oil-electric, switch engines with 300-hp. Diesel engines; the American Rolling Mill Co. has ordered two of the same type for their Ashland, Ky., plant; the Lackawanna Railroad has ordered 1,000 all-steel box cars, 250 all-steel coal cars, and two combination mail and baggage cars; and the Central Railroad of New Jersey has ordered 200 steel gondola cars. The American Locomotive Co. and the American Car & Foundry Co. received the majority of the orders. In addition, the New York Central has displayed interest in the machinery field, having purchased several machines for the New Harmony shops of the company, and having inquiries out for several more.

Orders and inquiries are holding up well in the district, with two factors having opposite effects maintaining the average. The first factor is the return of vacationing officials, with a consequent signing of orders which have been awaiting their approval, while the second factor is the approach of the Cleveland Show, and a resulting tendency on the part of buyers to hold off on purchases until they have seen what is new at the show. The month of August was considered, in most cases, as a good month, equal to July in point of sales, only a few dealers reporting a falling off. September is considered by most dealers to be a month that will show only a medium business, with a decided impetus in October after the show. Inquiries are coming in for lists of 15 to 20 tools, in sharp contrast with former single-tool lists.

Deliveries are no better in most cases, but are showing some tendency to improve. The continued slackness of deliveries is not, in the opinion of dealers, a result of increased orders, but rather the result of the long-continued attempt to catch up to schedule, which has succeeded in throwing the aforementioned schedule into a worse muddle than before. Deliveries range from 4 weeks on lathes, to February delivery on boring mills, and July delivery on one type of automatic lathe. Prices have shown no tendency to change. Leading purchasers of the week in addition to the railroads were the sheet-metal, copper, and electrical industries. The used tool demand is good, but very few good used tools are obtainable.

MILWAUKEE

Pending machine-tool business that is not yet closed has swelled to an unusual volume, delays being attributed chiefly to absence of executives over the end of the month and Labor Day, and also the desire of technical men to see the Cleveland exhibits before buying. While current business is light, inquiries are on the increase, and come from almost every branch of the metal-working industries. Woodworking plants are out of the market. Automobile manufacturers are not as active as they were in July, but have not curtailed orders to the extent expected. Makers of automotive parts, however, continue production almost at peak and remain in the market to the same extent as in recent months.

Many jobbing machinists report that last August was the busiest month experienced in years, and that it exceeded the spring months of 1929 in the volume of business done. While the marine demand is off, it is expected to revive sharply as a result of prosperity among the water carriers. New machinery and repairs in virtually every sort of factory are keeping the tool and die makers and dealers in mill supplies as busy as the machine shops. Producers of power transmission devices, steam specialties, and electrical equipment are all profiting from these sources. Many of these manufacturers and service organizations are doubling or even tripling their capacity by utilizing surplus space or renting old factory buildings.

Deliveries of machine tools are being slightly improved by reason of the recent lull and the increases in manufacturing facilities. Still further improvement is expected to take place early in the winter on account of improved production.

NEW ENGLAND

The volume of machine-tool business in this territory for August was below July totals. Certain machine-tool manufacturers, however, booked more new business in August than in the preceding month. Recessions were purely seasonal, and confined chiefly to the closing weeks of the month. The general business tone is healthy and the outlook excellent. Unfilled orders total a remarkable volume sufficient to keep top operations through the balance of the year. There seems to be small chance for improved deliveries on principal machine tools.

New England industrial indices, which were higher in July than for any other July on record, fell during August. The decline was slight and in no particular industry was the recession sufficient to reach normal for the month, according to unofficial data available at this time. Textile machinery improvement is encouraging and adds a new stability to the whole New England situation. All machinery distribution holds to a satisfactory level.

The Missouri Pacific R.R. has placed orders with the Bridgeport Safety Emery Wheel Co. for three No. 6 a.c. motor-driven floor grinders. Other orders placed in New England territory include a 54-in. Putnam tire-turning lathe.

PHILADELPHIA

Machinery and machine-tool manufacturers and agents in the Philadelphia area reported business up to expectations during the last two weeks, with orders coming in in fair volume and inquiries holding up well, despite the seasonal situation. The chief news of the week centered in the announcement that the New York Central R.R. has placed an order with an electric storage battery company in Philadelphia for thirty-five exide-ironclad locomotive storage batteries, to be used in the battery-oil-electric locomotives now being built by the company.

Orders for equipment from industrial plants came in good volume during the latter part of August. The automotive industry made some purchases from ball bearing manufacturers in this market, and the airplane industry was somewhat active in the same line. Unusual activity has been noted in the radio field.

Small tool dealers look for an active fall, and those engaged in production of the larger equipment believe the situation is hopeful. Repair work in numerous plants throughout the area has been active.

BUFFALO

Machine-tool trade in the Buffalo district during August was somewhat spotty. There is some evidence that buyers are holding off until after the Cleveland Show. On an average it is quite evident that the business of August, 1929, was fully as good as that of August, 1928, in the machine-tool and electrical equipment field. But this is not true of the dealers in contractors' equipment. The late spring and other adverse conditions conspired to give this business a set-back. There is one instance of a machine-tool dealer stating that his business in August this year was double that of August, 1928, but this is an exception.

The opinion seems quite general that after September and the Cleveland Show, there will be a big fall business so that the business for the year will be of exceptional proportions. This is also true in the electrical field, although the extent of summer prosperity is probably not quite so great as that in the machine tool field. The announcement that Donner Steel Co. is going to build a new mill in the immediate future at a cost of more than $1,000,000 has been hailed with keen interest.

DETROIT

Beginning shortly after Labor Day, conditions here have improved rapidly. Already, the sales of machinery and machine tools have reached a level far higher than the best period of August. A great many sales of equipment have been reported. Numerous inquiries are being received from automobile and accessories manufacturers, and there is a general atmosphere of expansion and development throughout the automotive industry. August was the poorest month in more than a year and a half, and all of the machinery and machine-tool dealers of Michigan experienced the depression to a greater or less degree. July was a fair month, although considerably below the level of the other months of the year in point of sales. August was far below July, not only in the matter of actual orders received, but also in regard to inquiries and general prospects. Six outstanding automobile manufacturers have placed fairly large orders for equipment in the past ten days, and a number of others have placed smaller orders. A good many manufacturers are making inquiries that will probably result in some large scale buying in the immediate future. Thus far this month, orders have been largely for replacement equipment. None of the orders have been for new work, and none of them indicate that expansion programs are being worked out at this time. Very little tool-room equipment is being sold now, and very little has been ordered within the past five or six weeks. Unless all of the present indications are misleading, the year 1929 should be better than the best year in the history of the trade here.

CINCINNATI

Owing to the Labor Day holiday, machine-tool manufacturers of the Cincinnati district report the market was somewhat sluggish the first part of the past week. Business soon revived, however, and at the end of the week things were normal and sales were at a good level. The general feeling is that the market trend will be upward through the present month.

Orders booked were well diversified as to sizes and types and the buyers were well scattered over the country. After a brief

post-holiday lull, inquiries began to flow in freely from all sections of the country, and while these were largely confined to single tools and replacements, it was noted that an increased percentage were in regard to more than one piece of equipment. Production continues at a good level and manufacturing conditions are favorable. There is no surplus of skilled mechanics, however, and it is feared that this may prove to be a handicap when the expected increase in the demand arises.

CLEVELAND

The local machine-tool market has been marking time for the past two weeks. Orders have been small in number, and generally for single machines for urgent replacement purpose only. The present laxity is attributed to the nearness of the coming machine-tool show. August proved to be one of the poor months of the year, the volume of orders received just about equalling those received in July but in dollar and cents valuation far below those of any month of the year and far less than the same month of last year.

General activity, however, showed an increase during August. The "falling off," regarded by some as almost inevitable, failed to develop. Building permit statistics for new industrial construction show a 500 per cent gain for the last month over those of 1928. Expansions of floor space and the acquisition of new tools are contemplated for the near future by the Cleveland Tractor Co., Globe Steel Barrel Co., and the Glunts Brass Co. The Hill Clutch and Machine Co., has absorbed the Lambert Machine and Engineering Co., and will produce their boring mills.

Export business is good. The National Acme Co., has received an order aggregating about $50,000 for screw machines for the Japanese arsenal.

CHICAGO

The advent of September brought with it a general resumption of prevacation period activities in the machine-tool industry, practically all executives and sales managers being again at their desks. Inquiries among manufacturers' representatives and sales agents in the machinery field with respect to August business, brought the information that, in the majority of cases, the volume was fully up to that of July, in some instances ahead of it. Practically without exception, heads of machine-tool concerns are in agreement regarding the outlook for the remainder of this year, which they declare to be most encouraging. Railroads, among them the Union Pacific, Northern Pacific and Chicago, Milwaukee, St. Paul and Pacific, are sending out inquiries on equipment to be listed in their 1930 budgets. The Pullman Co. is in the market for a number of units required for its Buffalo shops. Although the International Harvester Co. is reported to have bought most of the standard equipment for its Rock Island tractor plant, there still remain to be acquired a number of subsidiary items in the way of special tools. General buying by industrialists at this time is said to be limited to necessities, the purchase of important equipment being deferred until the exhibits and demonstrations at the forthcoming Machine Tool Show at Cleveland have been seen. Dealers in used tools say there is little improvement in their market, business being dull at the present time.

Business Items

The Peden Iron and Steel Co., Houston, Tex., has purchased the assets of the E. L. Wilson Hardware Co., Beaumont, Tex., and will continue to operate the company. E. G. Edson, former president and general manager of the Wilson company, and Virgil Keith, former vice-president, will be elected directors of the Peden company, and the remainder of the Wilson organization will be maintained intact. E. A. Peden is president, and D. Peden is vice-president and treasurer. B. F. Watts, Jr., is general manager.

The Tyson Roller Bearing Co., Canton, Ohio, will begin work within a few days on the first unit of a plant for the manufacture of a new type of roller bearing invented by Frank Tyson, mechanical engineer of that city. The company was recently organized and incorporated for $3,000,000. Tyson will be chief engineer of the new organization and is now making special machinery to be used in making this bearing.

The Lewis-Shepard Co., Watertown Station, Boston, Mass., recently purchased a brick manufacturing building containing approximately 60,000 sq.ft. of floor space at Crawfordsville, Ind. The building will be converted into a branch factory of the company to serve customers west of Cleveland. The new plant is expected to be in production by October 1.

The Worthington Pump & Machinery Corporation, Harrison, N. J., is forming an export subsidiary to consolidate its foreign business, similar to the export subsidiary of General Motors and other firms. The Worthington company has British, French, German, Hungarian, Austrian, and Italian subsidiaries at the present time.

Danly Machine Specialties, Inc., has opened recently an assembly plant and warehouse at Cleveland, Ohio. All shipments of die sets and die maker's supplies for the State of Ohio, except those for the City of Toledo, will be made from Cleveland.

The Wisconsin Ornamental Iron & Bronze Co., 1665 Booth St., Milwaukee, a subsidiary of the General Bronze Co., Long Island City, N. Y., has started construction of a 76 x 116-ft., one-story addition to its brass foundry, to cost $40,000.

The Wisconsin Axle Co., Oshkosh, Wis., is building an addition to the machine shop which will increase the floor space of that department 25 per cent. The addition will be of concrete, brick, and steel construction, one story in height.

The Boiler Tank and Pipe Co., Oakland, Calif., is erecting a plant for the manufacture of tubular steel products. The first all-steel unit, 70x350 ft., is now under construction. The new plant will employ 100 men.

The Bethlehem Steel Co., Bethlehem, Pa., is expanding its executive headquarters by adding six stories to its present office building. The completed building will be 13 stories in height.

The Noma Electric Co. and the Pilot Radio Tube Co., New York, have purchased the plant of the Everett Mills, Lawrence, Mass., comprising 15½ acres of land and two mill buildings each seven stories in height, comprising 1,500,000 sq.ft. of floor space. Production activities of both companies will be transferred within a year to the new plant.

The Standard Safety Razor Co., New York, which established a plant at Norwalk, Conn., several months ago, will remove its general office from New York to Norwalk.

The Northern Engraving Co., 200 Main St., LaCrosse, Wis., manufacturer of automobile dash boards, is starting construction of 100 x 200 ft. one-story addition.

The Warner Gear Co., a division of the Borg-Warner Corporation, is completing a $1,250,000 addition to its plant at Muncie, Indiana.

The Outboard Motors Corporation, 27th St. & Capitol Drive, Milwaukee, has awarded a contract for a new plant.

The Rome Iron Mills, Inc., has leased their plant at Rome, N. Y., to the Wrought Iron Co. of America. The mill organization has been retained.

The Simmons Co., Milwaukee, has started construction of a $100,000 plant addition.

The American Foundry Equipment Co., Mishawaka, Ind., is building an addition to its plant.

The Chase Brass & Copper Co., Waterbury, Conn., has opened a branch warehouse in Minneapolis.

The Eaton Axle & Spring Co., Cleveland, is building a 1-story assembly plant addition.

The Toledo Steel Products Co. has purchased the controlling interest in the Fostoria Screw Co., Fostoria, Ohio.

Personals

FERDNAND TURRETTINI, director general of the Societé Genevoise d'Instrument de Physique, Geneva, Switzerland, arrived in the United States on Sept. 3 for a stay of several weeks. Mr. Turrettini will visit the National Machine Tool Builders' Show and also the plants of a number of the machine-tool and machinery manufacturers of the United States.

RALPH SCOTT, formerly sales manager of the drill division of the Gardner-Denver Co., Denver, Colorado, is enroute to London where he is to be stationed permanently. W. G. AGNEW, who was until recently Gardner-Denver sales representative in Arizona, leaves soon for Lima, Peru, to take charge of the office there.

J. M. ROTH, founder of the Copperweld Steel Co., has resigned as chairman of the board of directors, and HARRISON NESBIT, president of the Bank of Pittsburgh National Association, was elected to fill that office. Mr. Roth, who is the inventor of the hot molten weld-

ing process for making Copperweld wire and other products, will continue as a director. FRANK R. FROST, president of the Superior Steel Company was also elected a director.

JAMES WORK has been appointed vice-president of the Detroit Aircraft Corporation. Mr. Work was chief engineer of the Naval Air Station at Lakehurst from 1922 to 1926, and since then has been assistant general manager of the aircraft factory.

H. P. CREIGHTON recently purchased the interests of the P. J. Schneider estate in the American Tool and Manufacturing Co., Urbana, Ohio. Mr. Schneider died about two months ago and Mr. Creighton exercises the rights of the surviving partner.

E. V. ROHR has been appointed assistant to John E. Eckenrode, vice-president in charge of sales for the Grand Rapids Metalcraft Corporation, Grand Rapids, Mich. His headquarters will be in the General Motors Building, Detroit.

JAMES S. MURRAY, 258 Maybrick Ave., Pittsburgh, Pa., and H. S. Huncke & Co., 27 So. Jefferson St., Chicago, have been appointed representatives of the Siewek Tool Co., 10232 Woodward Avenue, Detroit, Michigan, in their respective districts.

JOSEPH H. DILLON has been appointed chief engineer of the Wisconsin Steel Works of the International Harvester Co., Inc., South Chicago, Ill. He succeeds William Forstrom, who recently resigned.

R. L. TRIPLETT has been elected president and N. W. CUNNINGHAM has been elected treasurer of the Diller Manufacturing Co., Bluffton, Ohio, to succeed the late Waldo E. Diller, former president and treasurer.

H. E. WALDRON, vice-president and general sales manager of the W. A. Sheaffer Pen Co., New York, has been elected a member of the board of directors of the Williams Alloy Co., Elyria, Ohio.

FRED R. SEGHERS, formerly associated with the Chicago office of the Toledo Machine & Tool Co., has been appointed district sales representative for the Ferracute Machine Co., Bridgeton, N. J.

J. E. MCLARTY, former service manager of the Hudson Motor Car Company, Detroit, was recently promoted to be sales promotion manager.

MRS. K. V. TUCKFIELD has been appointed advertising manager of the Dardelet Thread Lock Corporation, 120 Broadway, New York.

C. H. LAGE has become associated with the Caterpillar Tractor Co., Peoria, Ill. He was formerly with the International Harvester Company.

RALPH F. PEO was elected vice-president and general manager of the Houde Engineering Corporation, Buffalo, at a recent meeting of the board of directors. At the same time, CLAIR BARNES, President of the Houdaille-Hershey Corporation, was elected president of the Houde Corporation to succeed A. B. Shultz, who recently resigned.

Obituaries

EDWARD BEECH CRAFT, executive vice-president of the Bell Telephone Laboratories, died Aug. 20, at his home in Hackensack, N. J., after an illness of several months. He was 47 years of age. Mr. Craft was graduated from the high school, Warren, Ohio, and he started work there. From 1900 to 1902, he was superintendent of the Warren Electrical and Specialty Co. In 1902, he resigned to go to Chicago to apply for a position with the Western Electric Co. Shortly afterward, he began working on development lines and is now credited with more than 60 inventions, including an indicating device for fuses which protects telephone equipment from dangerous electrical disturbances, so correct in design that it has remained constantly in use in telephone systems for the last 23 years. In 1907, Mr. Craft came to New York as development engineer. In 1918, he became assistant chief engineer and in 1922 chief engineer. He was vice-chairman of the division of engineering and industrial research of the National Research Council, chairman of the board of the Engineering Societies Library, a fellow of the A.I.E.E. and the Institute of Radio Engineers, and a member of other scientific societies and engineering clubs.

GEORGE W. THOMSON, mid-west district manager of the Norton Co., Worcester, Mass., died Thursday, Aug. 22 at Chicago, after a brief illness. He had been with the Norton Co. for 31 years, serving successively as head of its billing department, salesman in Connecticut and Philadelphia, and since 1915 as district manager for the Grinding Wheel Division with headquarters at Chicago.

EDWARD WORCESTER, formerly vice-president in charge of sales of the National Tube Co., McKeesport, died Aug. 29 at Pittsburgh. He had been connected with the National company for 25 years before his resignation in 1922, having been vice-president since 1903.

EDWARD T. JONES, chief engineer of the Curtiss-Wright Aeronautical Corporation, Paterson, N. J., died on Aug. 30 at his home in that city, after an illness of three months with typhoid fever, which he contracted while on a vacation in Jamaica, British West Indies. Mr. Jones was graduated from Cornell University in 1911 and taught mechanical engineering for four years in Sibley College, Cornell University, following graduation. In 1916, he entered the government aviation service and during most of the war was an aviation engineer at McCook Field, Dayton, Ohio. For four years after the armistice he continued in the government service as chief of the power plant section of the engineering division of the Army Air Service. Since 1925, he had been with the Wright Aeronautical Corporation. He was 40 years of age.

ALFRED E. MCCORDIO, president of the Illinois Power and Equipment Co., Chicago, died on Aug. 30, in St. Luke's Hospital after a short illness. He was 67 years of age.

Forthcoming Meetings

NATIONAL METAL CONGRESS. To be held in Cleveland September 9 to 13. Simultaneous meetings of the American Welding Society, the Institute of Metals Division, American Institute of Mining & Metallurgical Engineers, Iron & Steel Division, American Society of Mechanical Engineers, the Iron & Steel Division, A.I.M.E., and the American Society for Steel Treating. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

NATIONAL METAL EXPOSITION. Eleventh annual, held under the auspices of the American Society for Steel Treating, Cleveland Public Auditorium, Cleveland, Sept. 9-14. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

AMERICAN RAILWAY TOOL FOREMEN. Annual convention at Hotel Sherman, Chicago, September 11 to 13. C. C. Ziegler, secretary-treasurer, 611 West Washington Blvd., Chicago.

MACHINE TOOL BUILDERS EXPOSITION. Under the auspices of the National Machine Tool Builders Association, Sept. 30 to Oct. 4, in the Public Auditorium, Cleveland, Ohio. Ernest F. DuBrul, general manager, 1415 Enquirer Bldg., 617 Vine St., Cincinnati.

NATIONAL SAFETY COUNCIL. Eighteenth annual meeting, to be held in Stevens and Congress Hotels, Chicago, Sept. 30 to Oct. 4. William H. Cameron, 108 East Ohio Street, Chicago, is managing director.

SOCIETY OF AUTOMOTIVE ENGINEERS. Production meeting at Hotel Cleveland, Cleveland, Ohio, Oct. 2 to 4. Coker F. Clarkson, 29 West 39th St., New York, is secretary.

SOCIETY OF INDUSTRIAL ENGINEERS. Sixteenth national convention at Hotel Statler, Cleveland, October 23 to 25. Requests for programs should be sent to S.I.E. national office, 205 West Wacker Drive, Chicago.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION. Semi-annual fall meeting at the Benjamin Franklin Hotel, Philadelphia, October 24 to 26. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland.

THE WEEKLY PRICE GUIDE . . .

Rise and Fall of the Market

BUYING is seasonally slow in iron and steel, with prospect of a revival in demand early in the fall. Slowing-down is particularly noticeable in purchasing of steel for railroads and the automotive industry. Requirements continue in large volume for construction and implement manufacturing. The principal price changes of the week, in the accompanying table, were the following: lead, up 0.05c. per lb. (6.6c.), East St. Louis; antimony, up ¼c. per lb. (11¼c.), New York; linseed oil, up 0.6c. per lb. (14.2c.), New York; solder, down ¼c. per lb. (33¼c.), New York.

(All Prices as of Sept. 6, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$17.69@$18.19
Northern Basic	19.90
Southern Ohio No. 2	19.90
NEW YORK—Tidewater Delivery	
No. 2 Southern (silicon 1.75@2.25)	19.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	14.00@14.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.26@21.76
Virginia No. 2	24.04
Basic	19.75@20.25
CHICAGO	
No. 2 Foundry, local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	20.01
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	20 26
Basic	20.26
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed*	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.30	3.90†
No. 12	2.15@2.25	3.45	3.35	3.95†
No. 14	2.25@2.35	3.55	3.45	4.00†
No. 16	2.35@2.45	3.65	3.55	4.10†
Black				
Nos. 18 to 20	2.65	3.85	3.70	3.80
No. 22	2.80	4.00	3.85	3.95
No. 24	2.85	4.05	3.90	4.00
No. 26	2.95	4.15	4.00	4.10
No. 28	3.10	4.75	4.15	4.25
Galvanized				
No. 10	2.70@2.80	4.20	4.05	4.05
Nos. 12 to 14	2.80@2.90	4.30	4.15	4.15
No. 16	2.90@3.00	4.40	4.25	4.25
No. 18	3.05@3.15	4.55	4.40	4.40
No. 20	3.20@3.30	4.70	4.60	4.55
No. 22	3.25@3.45	4.75	4.65	4.60
No. 24	3.50@3.60	4.90	4.75	4.75
No. 26	3 65@3.75	5.15	5.00	5.00
No. 28	3.90@4.00	5.40	5.25	5.25

*Light plates. †Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

— Thickness — B.w.g. and Decimal Fractions		Outside Diameter in Inches ¼	⅜	½	⅝	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.60	3.65	3.60
Cold drawn, flat or square‡	4.10	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.30†	3.00	3.00
Soft steel bar shapes	3.30†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.25	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, ⅜-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— 3/32, 8.35c. per lb.; ⅛, 7.85c. per lb.; 5/32 to ¼, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			49.00
Lead, pigs, E. St. Louis	6.60	New York	8.00
Zinc, slabs, E. St. Louis	6.80	New York	8.25

	New York	Cleveland	Chicago
Antimony, slabs	11.25	12.25	14.50
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	19.87½	19.87½	19.87½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	24@25	24.30	24.30
Zinc sheets (casks).....	10.50@11.00	11.70	10.11
Solder (½ and ½).....	33.25	32.75	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			65.00
Commercial genuine, intermediate grade.....			48.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt.....			12.00

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold drawn.....	53.00	40.00
Tubing	75.00*	90.00†
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	15.50 @15.62½	13.50	13.00 @14.00
Copper, heavy, and wire..	14.25 @15.50	13.00	12.00 @13.00
Copper, light, and bottoms	13.00 @13.50	12.50	11.00 @12.00
Heavy lead.....	5.37½@ 5.62½	6.25	4.75 @ 5.25
Tea lead.....	3.75 @ 4.00	4.25	3.75 @ 4.25
Brass, heavy, yellow.....	8.25 @ 8.75	8.00	8.00 @ 8.50
Brass, heavy, red.....	12.00 @12.50	12.50	11.75 @12.25
Brass, light.....	7.00 @ 7.50	7.50	7.00 @ 7.50
No. 1 yellow rod turnings.	9.50 @10.00	9.00	9.00 @ 9.50
Zinc.....	3.25 @ 3.75	3.25	3.00 @ 3.25

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.142	.11	.138
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.75	.60	65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	24
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.033	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.036	.036	.034
Brass rods.....	per lb..	.2125	.2125	.17
Solder (½ and ½).....	per lb..	.3325	.3375	.3225
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.60	3.05
Lard cutting oil.....	per gal.	.75	.75	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.86	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.08	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.65@2.75
Coke, prompt foundry, per net ton...	Connellsville,		3.75@4.85
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, ⅞-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Mass., Boston — Heil Hoist Co., 26th and Montana Sts., Milwaukee, Wis.—one 3 ton traveling crane for proposed 1 story mounting service station and warehouse here.

Mass., Boston—Johnson Co., 121 Chandler St.—saw table with jointer to run on ¼ hp. motor.

Mich., Detroit—Bull Dog Electric Products Co., 7610 Jos. Campau Ave. (electric switches, etc.) —machine shop equipment for proposed addition to plant.

Mich., Detroit—Manufacturers Steel Supply Co., 2162 Clay Ave.—cut-off machine and equipment.

Mich., Detroit—Wolverine Screw Co., 624 St. Jean Ave. (screw products and machine work) —milling machine and equipment.

Mo., St. Louis—Black Servant Mfg. Co., 2951 North Market St., W. F. Brinkman, Pres. — lathe, straight drills, Fosdick radial drill, Weigel upright drill, two Champion upright drills, shaper, 24 in. Smith-Mills shaper and 3-B Brown & Sharpe milling machine, for proposed 1 story, 100 x 185 ft. addition to factory on North Market St. Estimated cost $25,000.

O., Athens—Taylor Sherrard Machine Works, Inc., D. R. Taylor, Gen. Mgr.—equipment including lathe, grinder, drill press, air compressor, etc., for new plant.

O., Cincinnati—Bd. of Education, Administration Bldg., 216 East 9th St., C. W. Handman, Bus. Mgr.—will receive bids until Sept. 23 for machinery, tools and equipment, including battery repair equipment, electric drills and grinders, garage, machine shop and woodworking equipment, sheet metal tools, etc., for Automotive Trades School.

O., Cleveland—Karscher Coal Co., 2280 West 3rd St.—Universal swing crane with bucket.

Ore., Portland — R. McIntire — machinery, boilers, engines, etc., for proposed factory at Oceanic Terminal for the manufacture of grocers and bakers supplies. $500,000.

Tex., Big Springs—Texas & Pacific Ry. Co., F. S. McClung, Purch. Agt., Dallas—machinery and equipment for machine and blacksmith shops for proposed railway division terminal here. Estimated cost $1,000,000.

Opportunities for Future Business

Calif., Emeryville—Merchant Calculating Machine Co., awarded contract for a 2 story addition to factory. Estimated cost $40,250. Noted Aug. 15.

Calif., Fresno—Fresno Auto Body & Fender Works, 1919 Calaveras St., plans the construction of a 1 story shop including sheet metal working department, paint shop, repair department, etc., at Calaveras and H. Sts. Estimated cost $40,000. E. J. Kump Co., Rowell Bldg., Archt.

Calif., Oakland—City plans the construction of a machine shop and corporation yard quarters for repair of county equipment, etc., at ft. of 5th St. Estimated cost $75,000.

Calif., Oakland—Durant Motor Co. of California, 10910 East 14th St., will build addition to factory at 14th St. and 107th Ave. Estimated cost $50,000.

Calif., Westwood — University of California, Berkeley, is having plans prepared for the construction of a 1 story, 120 x 150 ft. mechanical arts building, including machine shops, etc., at University campus. Estimated cost $40,000. E. W. Maybury, 816 West 5th St., Pasadena, Archt.

Conn., Hartford—Superior Spring & Mfg. Co., 373 Washington St., is having sketches made for a 2 story, 55 x 130 ft. factory. Karl Schulz, Sr., 118 Sheffield St., New Haven, Archt. Noted Aug. 29.

Conn., Mystic—Almac Yacht Corp., Pistol Point, is having preliminary plans prepared for a 1 story, 50 x 150 ft. shop. Estimated cost $40,000. Private plans.

Conn., Stamford — Pitney-Downes Postage Meter Co., Pacific St., awarded contract for a 2 story, 60 x 300 ft. addition to factory. Estimated cost $150,000. Noted Aug. 29.

Ill., Cicero—Taylor Forge & Pipe Co., West 14th St., awarded contract for a 1 story addition to factory for the manufacture of spiral riveted pipe and pipe flanges.

Ill., Granite City—Universal Aviation Corp., 300 North Broadway, St. Louis, plans the construction of an airport development including hangars, shops, etc., here.

Ind., Fort Wayne — Capehart Co., is having plans prepared for the construction of a factory for the manufacture of phonographs on East Pontiac St. Estimated cost $43,000. C. R. Weatherhogg, 205 West Wayne St., Archt.

Ind., Fort Wayne—Tokheim Pump Co., 1602 Wabash Ave., awarded contract for a 30 x 800 ft. factory. Estimated cost $100,000. Noted Sept. 5.

Ind., Kokomo—Firestone Tire & Rubber Co., South Main St., Akron, O., is having plans prepared for the construction of a master service station at Union and Mulberry Sts., here. Estimated cost $75,000. Bishop-Knowlton & Carson, 312 North Meridian St., Indianapolis, Archts.

Ind., South Bend—Bendix Brake Co., awarded contract for a 2 story, 40 x 150 ft. factory on Bendix Dr. Estimated cost $42,000.

Ind., South Bend — Edwards Iron Works, awarded contract for a 1 story, 200 x 325 ft. factory at Main and Woodside Sts. Estimated cost $50,000.

Mass., Falmouth—J. L. Nickerson, Main St., is having plans prepared for the construction of a 1 story repair and service garage on Hadden Ave. Estimated cost $40,000. Private plans.

Mich., Battle Creek—Battle Creek Gas Co., awarded contract for the construction of a 3 story, 95 x 101 ft. service building and office. Estimated cost $150,000.

Mich., Detroit—Chevrolet Motor Co., 3044 West Grand Blvd., awarded contract for a 1 story, 140 x 640 ft. machine shop at St. Aubin Ave.

Mich., Grand Rapids—Hayes Body Corp., 551 7th St. N. W., is receiving bids for a 3 story, 75 x 565 ft. body plant on Muskegon St. Private plans.

Mich., Monroe—Newton Steel Co., is having plans prepared for addition to steel plant, including power house, switch building and transformer platform, etc. A. G. McKee Co., Engr.

Miss., Crystal Springs—Planters Package Co., R. B. Thomas, Pres., plans to rebuild crate factory in units, first unit $150,000. Total cost $500,000.

Mo., Maplewood—Sunnen Products Co., 6417 Dale Ave., St. Louis, awarded contract for a 1 story, 120 x 168 ft. factory at Manchester and Bartold Sts., here. Estimated cost $65,000. Noted Aug. 15.

Mo., St. Louis — Bd. of Police Comrs., L. Hocker, Pres., 12th St. and Clark Ave., will soon receive bids for a 2 story, 60 x 80 ft. police station and 45 x 100 ft. garage at Florisant and Ruskin Ave. Estimated cost $200,000. Mauran, Russell & Crowell, 1620 Chemical Bldg., Archts.

Mo., St. Louis—Mack International Truck Corp., 2804 Pine St., awarded contract for a 1 and 2 story, 200 x 287 ft. automobile sales and service station at Chouteau and Jefferson Sts.

N. J., Grantwood—N. Manolio, 558 Anderson Ave., will build a 1 story woodworking shop, etc., on Anderson Ave. Estimated cost $50,000. R. J. Cadien, 545 Gorge Rd., Archt.

N. Y., College Point—Nimjeb Realty Corp., 16 Court St., Brooklyn, plans the construction of a 1 story, 100 x 100 ft. machine shop at 15th Ave. and 119th St., here.

N. Y., Elmhurst—S. Shea, 41-21 Elbertson St., plans the construction of a 60 x 106 ft. garage at Kingsland Ave. and Card Pl. Estimated cost $250,000.

N. Y., Glendale — B. Braunstein, 163-18 Jamaica Ave., Jamaica, plans a 2 story, 53 x 81 ft. plumbing supply shop at Cypress Hills Rd. and Myrtle Ave., here.

N. Y., Long Island City—Dictograph Products Co., 220 West 42nd St., New York, plans the construction of a 100 x 100 ft. plant at 95th Ave. and 149th St., here. Estimated cost $50,000. Barney Ahlers Construction Co., 110 West 40th St., New York, Archt.

N. Y., New York—Henry Freidman & Sons Realty Corp., 343 Lexington Ave., awarded contract for the construction of a garage, etc., at 609 West 134th St. Estimated cost $175,000. C. B. Meyers, 31 Union Sq., Archt.

N. Y., New York — E. R. Poerschke, 1442 Sedgwick Ave., plans the construction of a 2 story, 95 x 100 ft. garage at Sedgwick Ave. and 171st St. Estimated cost $70,000. Siegel & Levy, 1775 Broadway, Archts.

N. Y., New York—H. Ratner, 507 5th Ave., plans a 2 story, 100 x 150 ft. garage at Jerome Ave. and 176th St. Estimated cost $50,000. S. H. Kitzler, 358 Broadway, Archts.

N. Y., New York—F. L. Smithe Machine Corp., 633 West 44th St., plans the construction of a 5 to 6 story, 125 x 181 ft. shop and office. Estimated cost $40,000. R. G. Cory, 30 Church St., Archt.

O., Canton—Hercules Motor Corp., 140 Hallwell Pl. E. S., awarded contract for the construction of a 1 story, 93 x 200 ft. factory. Estimated cost $40,000.

O., Cleveland—Colonial Iron Works Co., C. Challinor, Ch. Engr., 17643 St. Clair Ave., plans a 1 story, 100 x 150 ft. addition to factory. Estimated cost $50,000. Private plans.

O., Cleveland—Eaton Axle & Spring Co., C. I. Ochs, Pres., East 65th St. and Central Ave., awarded contract for a 1 story, 55 x 126 ft. addition to assembly plant. Estimated cost $40,000.

O., Cleveland — Gluntz Brass Foundry Co., 10803 Harvard Ave., awarded contract for a 1 story, 30 x 80 ft. machine shop. Estimated cost $40,000.

O., Cleveland—Hill Clutch Machine & Foundry Co., 6400 Breakwater Ave., had plans prepared for a 1 story, 49 x 92 ft. addition to factory. Estimated cost $40,000. G. S. Rider Co., Century Bldg., Archt.

O., Cleveland—J. M. Sands Co., 5204 Sweeney Ave., manufacturer of water heaters, awarded contract for a 1 story, 65 x 68 ft. addition to factory. Estimated cost $40,000.

O., Cleveland—White Motor Co., G. H. Kelly, Treas., 842 East 79th St., awarded contract for a 1 story sales and service building at East 51st St. and St. Clair Ave. Estimated cost $150,000. Noted Feb. 21.

O., Dayton—Burkett Closed Body Co., Master Ave., plans a 1 story factory for the manufacture of truck and bus bodies on North Dayton St. Estimate cost $200,000.

Pa., Easton — Industrial Drinking Cup Co., awarded contract for a 3 story, 80 x 100 ft. factory. Noted Aug. 15.

Pa., Pittsburgh — A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt., will receive bids about Sept. 16 for the construction of a 2 story factory for the manufacture of automobile parts here, for Argonaut Realty Co., General Motors Bldg., Detroit, Mich. Estimated cost $150,000.

Pa., Pittsburgh—General Motors Corp., Research Bldg., Detroit, Mich., will soon award contract for a 1 and 2 story, 146 x 218 ft. service building at Braddock St. and Thomas Ave., here. A. Kahn, Inc., 1000 Marquette Bldg., Detroit, Archt.

Tex., San Antonio—E. Dittmar & Associates, Howard St., plans the construction of a 2 story, 71 x 273 ft. garage. Estimated cost $80,000. R. Vanderstraten, Travis Bldg., Archt.

Ont., New Toronto—Cleveland Trencher Co., 20100 St. Clair St., Cleveland, O., plans the construction of a plant for the manufacture of tractors, ditchers, etc., on 18th St. here. Estimataed cost $150,000.

Ont., Ottawa—Barrett Bros., Catharine St., awarded contract for a 2 story garage on Bank St. Estimated cost $55,000.

Ont., Ottawa—Majestic Motors Ltd., 146 Albert St., awarded contract for a 2 story, 100 x 100 ft. garage. Estimated cost $100,000.

Ont., Toronto—Hamilton Bridge Works Co. Ltd., 357 Bay St., plans the construction of a plant on Harbor front. Estimated cost $1,000,000.

Ont., Toronto—Parker Fountain Pen Co., 348 Sorauren Ave., plans the construction of a factory on Fleet St. Estimated cost $200,000. Architect not selected.

Que., Farnham—Canada Metal Products Ltd., plans the construction of a plant. Estimated cost $75,000.

Que., Levis—Howe Lumber Co., Three Rivers, plans the construction of a sawmill here. Estimated cost $75,000.

Russia, Nishi-Novgorod — Union Soviet Socialist Republica, awarded contract for the construction of an automobile manufacturing plant and power house, to Austin Co., 16112 Euclid Ave., Cleveland, O., Engrs. and Contrs. Estimated cost $10,000,000.